TBird* Ventilator Series

SERVICE MANUAL



Bird Products Corporation

L1314 Rev. B

April 2000

*TBird is a registered trademark in the U.S. and some other countries.

, which is the state of the st

TBird Ventilator Series Service Manual	MANUAL REVISION HISTORY	Bird Products Corporation
Pages	Revision	Date
	Rev. A	November, 1996
i, iv, v, xv Appendix , L1465	Rev. B	April, 2000
		e de la
	•	

USER RESPONSIBLITY WARNING

This service manual is intended for use by Bird Products Corporation trained and authorized service personnel. Bird Products Corporation does not condone or approve of service activity on its products by other than Bird Products Corporation trained or authorized personnel. BIRD PRODUCTS CORPORATION IS NOT RESPONSIBLE FOR ANY UNAUTHORIZED REPAIRS, OR ANY REPAIRS MADE BY UNAUTHORIZED PROCEDURES.

Use of the incorrect part or the failure to exercise due care in the installation, removal, servicing, checkout or calibration of parts and equipment may result in damage or possible malfunction of the equipment. This may also result in damage to property and injury including death. The purchaser and installer of these parts shall bear full responsibility and liability for the above.

All maintenance performed within the applicable warranty period (see warranty card) must be authorized in advance by Bird Products Corporation service representative in order to retain the warranty status of the subject unit.

WARRANTY

THE TBIRD VENTILATORY SYSTEMS ARE WARRANTED TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP AND TO MEET THE PUBLISHED SPECIFICATIONS FOR TWO (2) YEARS OR 8,000 HOURS, WHICHEVER OCCURS FIRST.

The liability of Bird under this warranty is limited to replacing, repairing or issuing credit, at the discretion of Bird, for parts that become defective or fail to meet published specifications during the warranty period; Bird will not be liable under this warranty unless (A) Bird is promptly notified in writing by Buyer upon discovery of defects or failure to meet published specifications; (B) the defective unit or part is returned to Bird, transportation charges prepaid by Buyer; (C) the defective unit or part is received by Bird for adjustment no later than four (4) weeks following the last day of the warranty period; and (D) Bird's examination of such unit or part shall disclose, to its satisfaction, that such defects or failures have not been caused by misuse, neglect, improper installation, unauthorized repair, alteration or accident.

Any authorization of Bird for repair or alteration by the Buyer must be in writing to prevent voiding the warranty. In no event shall Bird be liable to the Buyer for loss of profits, loss of use, consequential damage or damages of any kind based upon a claim for breach of warranty, other than the purchase price of any defective product covered hereunder.

Bird warranties as herein and above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of the rendering of technical advice or service by Bird or its agents in connection with the Buyer's order of the products furnished hereunder.

LIMITATIONS OF LIABILITIES

This warranty does not cover normal maintenance such as cleaning, adjustment or lubrication and updating of equipment parts. This warranty shall be void and shall not apply if the equipment is used with accessories or parts not manufactured by Bird or authorized for use in writing by Bird, or if the equipment is not maintained in accordance with a prescribed schedule of maintenance.

The warranty stated above shall extend for a period of two (2) years from date of shipment or 8,000 hours of use, for those products employing an hour meter, whichever occurs first, with the following exceptions:

- 1. Components for monitoring of physical variables such as temperature, pressure, or flow are warranted for ninety (90) days from date of receipt.
- Elastomeric components and other parts or components subject to deterioration, over which Bird has no control, are warranted for sixty (60) days from date of receipt.
- Internal and Optional External batteries are warranted for ninety (90) days from the date of receipt.

THE FOREGOING IS IN LIEU OF ANY WARRANTY, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY, EXCEPT AS TO TITLE, AND CAN BE AMENDED ONLY IN WRITING BY A DULY AUTHORIZED REPRESENTATIVE OF BIRD.

Copyright Notice

Copyright © 2000 by Bird Products Corporation, Palm Springs, California.

This work is protected under Title 17 of the US Code and is the sole property of Bird Products Corporation. No part of this document may be copied or otherwise reproduced, or stored in any electronic information retrieval system, except as specifically permitted under US copyright law, without the prior written consent of Bird Products Corporation. For more information, contact:

World Headquarters

Bird Products Corporation 1100 Bird Center Drive Palm Springs, CA 92262-8099 U.S.A

Phone: (760) 778-7200

(800) 328-4139

Fax: (760) 778-7274

Trademark Notices

TBird is a trademark of Bird Products Corporation. All other brand names and product names mentioned in this manual are trademarks, registered trademarks, or trade names of their respective holders.

PLEASE

Read this entire manual before attempting to service the ventilator.

Attempting to service the ventilator without fully understanding its features and functions may result in unsafe operating conditions.

Read the Safety Information section located immediately after the About This Manual chapter. It lists warnings, cautions, and notes pertinent to the safe servicing of the ventilator.

If you have a question regarding the installation, set up, operation, or maintenance of the ventilator, contact:

Customer Services

Hours: 7:00 AM to 3:30 PM (PST)

Monday through Friday

Phone: (760) 778-7200

(800) 328-4139

Fax: (760) 778-7274

Technical Services

Hours: 7:00 AM to 5:00 PM (PST)

Monday through Friday

Phone: (760) 778-7200

Fax: (760) 778-7274

BIRD Helpline

Hours: 24 hrs, seven days a week

Phone: (800) 934-BIRD

(800) 934-2473

World Headquarters

Bird Products Corporation 1100 Bird Center Drive Palm Springs, CA 92262-8099

U.S.A.

European Office

Bird Products Corporation

Rembrandtlaan 1b, 3723 BG Bilthoven

P.O. Box 299, 3720 AG Bilthoven

The Netherlands

Phone: (760) 778-7200 (31) 30 2289 711

(760) 778-7274 Fax:

(31) 30 2286 244

This page intentionally left blank.

CONTENTS AT A GLANCE

	About This Manual	Kiii
	Safety Informationx	χij
Chapter 1	Introduction1	-1
Chapter 2	Maintenance2	-1
Chapter 3	Service Verification Tests3	-1
Chapter 4	Technical Troubleshooting4	-1
Chapter 5	Removal And Replacement5	-1
Chapter 6	Schematics 6	i-1
Chapter 7	Parts List7	'-1
	Appendix	
	Index	
	Bulletins	

Service Manual November 1996 vii

TABLE OF CONTENTS

About '	This Manual	
	Purpose	ĸiii
	Intended Audience	ĸiii
	Organization	κiν
	Finding Information	χV
	Conventions	ΧV
	For More Information	χV
Safety	Information	
	Terms	xvi
	Symbols	xvi
	Warnings	vii
-	Cautions x	viii
Chapte	er 1 - Introduction	
	What This Chapter Describes 1	
	What You Need To Service The Ventilator 1	-1
		-1
	Required Tools 1	
	Required Power And Oxygen Sources 1	-2
Chapte	er 2 - Maintenance	
~	What This Chapter Describes 2	
	Recommended Schedule Of Maintenance 2	
	500 Hours Maintenance	
	5,000 Hours Maintenance	
	20,000 Hours Maintenance	!-3
Chapte	er 3 - Service Verification Tests	
	What This Chapter Describes 3	
	Service Verification Tests (SVT) Overview 3	
	Performing The SVT	
		3-5
	Calibration	
	Airway Pressure Transducer Calibration 3	
	Turbine Differential Pressure Calibration 3	
	Exhalation Differential Transducer Calibration 3	
	Oxygen Pressure Transducer Calibration 3	
	Turbine Serial Number Entry 3-	
•	Watch Dog Test 3-	10

November 1996

Onapoci	4 - teamment it annies mooning
	Monitor Window Messages 4-1
I	Event Detection Codes 4-11
(General Malfunctions 4-13
	Power Supply Voltage Check 4-17
Oh	E. Dameurl And Banksonnut
-	5 - Removal And Replacement
	What This Chapter Describes 5-1
	Table of Contents
	Ventilator Left and Right Side Cover Removal 5-3
	Top Cover
	Program Memory Card Removal
	& Configuration Memor y Removal 5-6
	Left or Right Protective Cover 5-8
	Power Supply Removal 5-9
	Internal Batteries 5-10
	Energy Storage Capacitor 5-10
	Motor Controller PCBA 5-12
	Watch Dog PAL5-13
	Panel Encoder Assembly 5-15
	Main PCBA
	Display PCBA
	Front Panel 5-15
	Control Panel
	Overlay 5-15
	Control Panel/Overlay 5-15
	7 Segment Red Display 5-17
	Dot matrix Displays 5-17
	Socketed LED 5-17
	7 Segment Yellow Display 5-17
	Muffler/Filter Core Assembly 5-18
	Exhalation Valve 5-19
•	Turbine Assembly
	Blender Assembly 5-21
	Fan Assembly 5-22
	Fan Inlet Filter 5-22
	Fan EMI Filter
	Patient Assist Call
	Standby/On Switch
	Fuse Holder
	Alarm Loudness Potentiometer 5-24
	EMI/DELER-on 5.24

Service Manual November 1996 ix

	Turbine Differential Pressure Transducer Exhalation Differential Pressure Transducer	5-25 5-26 5-26 5-27 5-27 5-28
	Wire Harness And Cable Assemblies	5-34
	F 6 - Schematics Wiring And Pneumatic Schematic Block Power Supply Main PCBA Display PCBA Blender PCBA External Battery Charger Patient Assist Call	6-2 6-17 6-23 6-36 6-40 6-41
Chapte	What This Chapter Describes Turbine/Muffler Assembly Front Panel Assembly Rear Panel Assembly Oxygen Blending Components Base Assembly Right/Left Side Assembly Top Cover Assembly Wire Harness And Cable Assemblies Main PCB Assembly Power Supply PCB Assembly	. 7-2 . 7-3 . 7-4 . 7-5 . 7-7 . 7-8 . 7-9 7-10 7-11
	Appendix Index Bulletins	, i

List Of Figures

Figure	Description Page	
3-1	Main PCBA	
3-2	Special Functions Group 3-3	
3-3	SVT Diagram)
3-4	Solenoid Test	Ì
3-5	Airway PressureTransducer 3-7	ļ
4-1	Power Supply	7
5-1	Ventilator Left and Right Side Cover Removal 5-3	3
5-2	Top Cover Removal	j
5-3	Program Memory Card and	
	Configuration Memory Card 5-8	3
5-4	Protective Side Covers 5-8	3
5-5	Power Supply Removal 5-9	
5-6	Internal Batteries/Energy Storage Capacitor 5-10)
5-7	Motor Controller 5-12	
5-8	Main PCB, Watch Dog PAL 5-13	3
5-9	Front Panel Disassembly 5-14	1
5-10	Front Panel Encoder Removal 5-15	5
5-11	Displays	7
5-12	Muffler/Filter Core Assembly 5-18	
5-13	Exhalation Valve 5-19	3
5-14	Turbine Assembly	J
5-15	Blender Assembly 5-2	1
5-16	Fan Assembly 5-2	2
5-17	Patient Assist Call 5-2	3
5-18	Turbine Differential Pressure Transducer and	
	Exhalation Differential Transducer 5-2	5
5-19	Base Plate O-Rings and	
	Anti-Suffocation Valve 5-2	6
5-20	Outlet Check Valve Assembly and	
	Relief Valve Assembly 5-2	7
5-21	Ventilator Base 6-2	8
5-22	Docking Bay Assembly 5-2	9
5-23	8 Position Connector 5-3	0
5-24	Right Side Cover 5-3	1
5-25	Power Supply PCBA 5-3	2
7-1	Turbine/Mufler Assembly	2
7-2	Front Panel Assembly 7-	
7-3	Rear Panel Assembly	

Service Manual November 1996 xi

List Of Figures (Continued)

7-4	Oxygen Blending Components 7-5
7-5	Base Assembly
7-6	Right/Left Side Assembly 7-8
7-7	Top Cover Assembly
7-8	Wire Harnesses And Cable Assemblies 7-10
7-9	Main PCB Assembly
7-10	Power Supply PCB Assembly

List Of Tables

Table	Description	Page
l	Manual Organization	xiv
1-1	Required Tools	. 1-1
2-1	Recommended Schedule of Maintenance	
2-2	5,000 Hour Replacement Components	. 2-2
2-3	20,000 Hour Replacement Components	
5-1	Wiring Connections	

ABOUT THIS MANUAL

Purpose

This manual shows you how to diagnose, service, and repair the TBird ventilator series. After reading this manual, you will understand:

- What the ventilator is and how it works.
- What regularly scheduled maintenance should be performed and when it should be performed.
- What tools and equipment are required to service the ventilator.
- What software tests are available in the ventilator to help you troubleshoot and calibrate the ventilator.
- How to remove and replace the critical components of the ventilator.
- How to completely disassemble and reassemble the ventilator.
- How to calibrate transducers and other internal components to make sure the ventilator is working properly.
- How to do a performance check.
- A complete set of schematics, an exploded view of the system, and an illustrated parts list is included.

Intended Audience

This manual is written for Bird Products trained and authorized service personnel. It assumes you are familiar with Bird Product ventilators and have attended the TBird ventilator series training class.





If you are not authorized by Bird Products to work on the TBird ventilator series, do not attempt to perform any of the procedures described in this manual. If you ignore this warning, you may create conditions that could be harmful to the patient, as well as void the warranty . DO NOT SERVICE THE VENTILATOR UNLESS YOU HAVE BEEN TRAINED AND AUTHORIZED BY BIRD PRODUCTS TO DO SO.

iiix Service Manual November 1996

Organization

This manual is organized as described in Table I.

Table I. Manual Organization

#	Title	Description
1	Introduction	Introduces the TBird ventilators and lists the tools and equipment you will need to service the ventilator.
2	Maintenance	Shows the recommended schedule of maintenance and gives procedures for performing scheduled maintenance after 500, 5,000 and 20,000 hours of operation.
3	Service Verification Tests	Shows you how to run the Service Verification Tests that are built into the ventilator's software. These tests help you troubleshoot the ventilator or verify that it is working properly.
4	Technical Troubleshooting	Shows you how to troubleshoot the ventilator when it doesn't power up properly, a vent inop condition exists, or otherwise doesn't appear to be functioning properly.
5	Removal and Repacement	Shows you how to remove and replace the major critical components of the ventilator.
6	Schematics	Contains a complete set of schematics.
7	Parts List	Contains an exploded view diagram of the ventilator and illustrations of each replaceable component or assembly.



Refer to the TBird Operator's Manuals, Appendix A for a glossary of terms.

Finding Information

This manual is designed to help you to quickly locate information. It features:

- Table Of Contents: Take a minute to look over the Table of Contents. It shows
 the material covered and the order in which it is covered. This will help you
 locate information more easily.
- Running Headers: The chapter title and primary topic covered on each page is
 printed in the upper, outer corner of the page to help you locate information by
 thumbing through the manual.

Conventions

The following print conventions are used in this manual:

- All front panel controls are printed in bold as follows: Breath Rate, Tidal Volume, and Sensitivity.
- All messages displayed in the monitor window or alarm window are printed in the following font: NO AC POWER, HIGH PRES, and XP no.n onH20.

For More Information

For more information contact Bird Products' Customer Service or Technical Support organizations at:

World Headquarters

Bird Products Corporation

1100 Bird Center Drive

Palm Springs, CA 92262-8099

U.S.A

Phone:

(760) 778-7200

(800) 328-4139

Fax:

(760) 778-7274

This page intentionally left blank.

SAFETY INFORMATION

Please review the following safety information prior to operating the ventilator.

TERMS

WARNINGS identify conditions or practices that could result in serious adverse

reactions or potential safety hazards.

CAUTIONS identify conditions or practices that could result in damage to the

ventilator or other equipment.

NOTES identify supplemental information to help you better understand

how the ventilator works.

SYMBOLS



This symbol indicates a WARNING.



This symbol indicates a CAUTION.



This symbol indicates a **NOTE**.

Service Manual November 1996 xvii



Refer to the TBird Operator's Manuals for operator safety information and warnings. The following warnings apply any time you are servicing the ventilator.

- If you are not authorized by Bird Products to work on the TBird ventilator series, do not attempt to perform any of the procedures described in this manual. If you ignore this warning, you may create conditions that could be harmful to the patient, as well as void the warranty. DO NOT SERVICE THE VENTILATOR UNLESS YOU HAVE BEEN TRAINED AND AUTHORIZED BY BIRD PRODUCTS TO DO SO.
- The Service Verification Tests (SVT) must never be performed when the ventilator is connected to a patient and therefore require specific and deliberate action on the part of the technician to enable them.
- The procedure for calibrating the Exhalation Differential
 Transducer requires the use of external pressure sources and
 external pressure monitoring. Do not select this test unless the
 required equipment is available. External values applied during
 these tests will change internally stored information in the
 ventilator. Performance and accuracy will be affected if external
 test equipment is not of the specified accuracy.
- Electrical shock hazards are present within the ventilator even after AC power has been removed. It is recommended that the top cover be electrically unplugged to disconnect the batteries from the ventilator.
- Electrical shock hazards are present within the ventilator even after AC power has been removed. Pay particular attention to the large electrolytic capacitor mounted to the top cover.



Refer to the TBird Operator's Manuals for operator safety information and cautions. The following cautions apply any time you are servicing the ventilator.

- Performing the 5,000 hour maintenance requires access to the interior of the ventilator. It is intended to be performed by a Bird Factory Trained technician. The technician should be familiar with appropriate ESD (Electro-Static Discharge) prevention techniques to avoid damage to electronic components.
- Double check the pneumatic connection to the T DIFF transducer before
 applying pressure. If the 60 cmH₂O pressure is inadvertently applied to the
 X DIFF transducer it will be permanently damaged and require replacement.
- Appropriate measures to prevent ESD damage to electronic components must be taken:
 - Wear a properly grounded and tested anti-static wrist strap when handling Printed Circuit Boards (PCBs).
 - Work on an anti-static surface.
 - Always use anti-static material for packaging PCB's.
 - Attached to the top cover of the ventilator is a large energy storage capacitor that may have some residual charge. Use extreme care not to allow any conductive material to contact the electrical connections.
- The Power Supply is mounted to the right side cover of the ventilator. Removal
 must be done carefully to ensure that wire harnesses are not strained and that the
 Power Supply components are not allowed to contact electrically conductive
 materials of the ventilator including the shield coating on the inside of the
 ventilator.
- When handling the Program Memory Card and contacting the inside of the
 ventilator, precautions must be taken to avoid ESD damage. An anti-static wrist
 strap should be worn and correctly grounded while performing this procedure.
 At a minimum, always touch the copper colored coating inside of the chassis to
 equalize potential charges prior to placing the card in the ventilator.
- Before assembling the ventilator, be sure to double check the alignment of connector J5. Misalignment of this connector can cause catastrophic damage to the Power Supply and/or the Main PCB.
- Prior to cover removal, disconnect AC power from the wall source and ensure that the Stand By/On Switch is in the Stand By Position.

This page intentionally left blank.

CHAPTER 1 INTRODUCTION

What This Chapter Describes

This chapter describes what you will need to service the ventilator series. Please refer to the TBird VS/VSO₂ Operator's Manual (P/N L1310) and the TBird AVS Series Operator's Manual (P/N L1331) for complete information on the operation of the TBird ventilator series.

What You Need To Service The Ventilator

To service the ventilator, you need the following:

- Training or authorization from Bird Products.
- Required tools as specified below.
- Power and oxygen sources.

Required Training Or Authorization

Only Bird certified and authorized service personnel are permitted to service the ventilator. If you are not certified or authorized, please do not attempt to perform any of the service procedures listed in this manual.

Required Tools

All components of the TBird ventilator can be removed and replaced using the tools listed Table 1-1. These tools can be acquired from your local hardware store or supplier. Bird Product's does not sell these tools.

Table 1-1. Required Tools	
Phillips Cross-tip screwdriver	
Pliers	
Needle Nose Pliers	
Thin Walled 11/32-inch socket or nut driver	
IC removal tools	
Anti-static wrist strap	
Common screwdriver	

Service Manual November 1996 1 - 1

Required Power And Oxygen Sources

To operate the ventilator you need a power source and oxygen source:

- Power Source. The ventilator operates from a standard 100, 110, 220, or 240 VAC. power source, the internal battery, or an optional external 48 VDC Supply (4 x 12 VDC batteries). The ventilator comes factory equipped with a built-in battery, capable of providing power during short-term patient transports or AC power interruptions. The optional external battery can be used for longer term support.
- **Pressurized Oxygen**. The compressed oxygen source must provide clean, dry, medical grade oxygen at a line pressure of 40 to 60 PSIG (2.8 to 4.2 bar).
- Low Pressure Oxygen (VS only). The low flow oxygen source must provide clean, medical grade oxygen at flows of 0 to 80 lpm and a pressure not exceeding 0.5 PSIG (0.35) bar.

CHAPTER 2 - MAINTENANCE

What This Chapter Describes

This chapter describes the recommended maintenance to be performed on the ventilator after 500, 5,000, and 20,000 hours of operation. After reading this chapter you will understand:

- What scheduled maintenance is required and when it is required.
- How to perform the required maintenance.

Recommended Schedule of Maintenance

The TBird ventilator is designed to operate for long periods of time with very little maintenance. Table 2-1 gives a recommended schedule for maintaining the ventilator and describes the tasks that should be performed at each of the scheduled maintenance times.

Table 2-1. Recommended Schedule Of Maintenance

Schedule	Maintenance
Every 500 Hours	Clean the air intake and fan intake filters, replacing them if necessary. Check the exhalation valve body, O-rings and diaphragm, replacing them if necessary. Refer to the TBird Operator's Manual, Chapter 9, Cleaning & Sterilization.
Every 5000 Hours	Perform extended maintenance, replacing specific internal and external components. Check out the ventilator and calibrate as required.
Every 20,000 Hours	Perform a complete maintenance procedure, replacing components that are approaching the end of their useful life.

This schedule assumes the ventilator is operating in a typical clinical setting. Environmental conditions may necessitate more frequent maintenance.

Service Manual November 1996 2 - 1

500 Hour Maintenance

Every 500 hours, perform the following:

- 1. Clean the air intake and fan intake filters, replacing them if necessary.
- 2. Check the exhalation valve body, O-rings and diaphragm, and replace them if necessary. Refer to the TBird Operator's Manual, Chapter 9, Cleaning & Sterilization.

5,000 Hour Maintenance

After 5,000 hours of operation, extended maintenance is required. During this maintenance, several internal and external components need to be replaced. The ventilator also needs to be checked out and, if necessary, calibrated.

Table 2-2. 5,000 Hour Replacement Components

Part	P/N
Muffler Tube O-Rings	30020
Muffler/Filter Cores	10365
Rear Inlet Filter	20819
Fan Filter	33749

To perform the 5,000 hours maintenance, do the following:



CAUTION



Performing the 5,000 hour maintenance requires access to the interior of the ventilator. It is intended to be performed by a Bird Factory Trained technician. The technician should be familiar with appropriate ESD (Electro-Static Discharge) prevention techniques to avoid damage to electronic components.

Remove the left and right side panels from the ventilator as described in Chapter
 Removal & Replacement.

2. Remove and replace the Muffler/Filter Cores and O-Rings as described in Chapter 5, Removal & Replacement.



Note

If the inlet filter to the turbine is found to be excessively dirty, the interval between replacement of the internal filter should be reduced to prevent malfunction or damage to the ventilator.

- 3. Reassemble the ventilator but do not install the left side panel so that the SVT may be performed later in this procedure.
- Check the exhalation valve body, O-rings and diaphragm, and replace them if necessary. Refer to the TBird Operator's Manual, Chapter 9, Cleaning & Sterilization.
- Replace the Fan Filter and the Air Inlet Filter. Refer to the TBird Operator's Manuals.
- 6. Perform the UVT as described in the TBird Operator's Manual and the SVT as described in this manual.
- 7. Ensure that DIP switch 1 is in the OFF position.
- Reassemble the left side panel.
- Perform the operational check as described in the TBird Operator's Manuals.

20,000 Hour Maintenance

After 20,000 hours of operation, the assemblies listed in Table 2-3 will require replacement. Refer to Chapter 5, Removal and Replacement for detailed instructions.

Prior to disassembly, the ventilator should be inspected for any external damage requiring additional replacement. Particular attention should be paid to the following:

- External hardware of the ventilator
- The Power Cord
- The Control Panel and Overlay

Any of these items that need replacement will have to be ordered in addition to the parts specified below.

Service Manual November 1996 2 - 3

As the ventilator is being disassembled, the interior of the ventilator should be inspected for the following:

- Accumulation of dust or lint
- Appearance of liquid entry into the ventilator
- Damage to electrical wiring by chafing or pinching
- Secure electrical connection
- Damage to tubing by chafing or kinking

If any of these conditions are found to be present, appropriate cleaning and replacement should be accomplished before proceeding or the unit should be returned to Bird Products for more extensive repair.

Table 2-3. 20,000 Hour Replacement Components

Part	P/N	
Turbine	15430A	
Muffler Tube O-Rings	30020	
Turbine Base Gasket	20754	
Manifold Base O-Rings	04358, 30018, 30023	
Anti-Suffocation Valve	20651	
Pressure Relief Valve O-Rings	30017, 30005	
Outlet Check Valve and O-Rings	05625, 30005,30019	
Exhalation Valve	15429	
Muffler/Filter Cores	10365	
Internal Batteries (4)	20811	
Blender Assembly (VSO ₂ /AVS)	15433A	
Fan	15500	
Rear Inlet Filter	20819	
Fan Filter	33749	
O ₂ Bleed Tube	20927	
O ₂ Inlet Hose	00666	

After performing the 20,000 Hour Maintenance, the following procedures must be performed to help ensure that the ventilator is prepared to be returned to service.

Follow the instructions in the SVT section of this manual to perform the calibrations of the:

- a. Turbine Differential Transducer
- b. Exhalation Differential Transducer
- c. Airway Pressure Transducer
- d. Oxygen Pressure Transducer (VSO₂/AVS).
- Perform Transducer tests and the UVT as described in the TBird Operator's Manuals. This may indicate the presence of leaks which must be corrected prior to proceeding.
- 2. Perform the operational check as described in the TBird Operator's Manuals.

Service Manual November 1996 2 - 5

CHAPTER 3 - SERVICE VERIFICATION TESTS

What This Chapter Describes

The Special Functions programmed into the TBird Ventilator Series allow the operator to obtain information, change parameters, and perform calibrations that are not available during normal operation. Included are the following functions:

- Configure the ventilator
- Monitor pressure transducer operation
- Check the hour meter, software revisions, and event code history
- Test the visual displays, control panel, filters, and perform leak testing
- Manually control internal ventilator functions
- Calibrate the pressure transducers

Service Verification Tests (SVT) Overview





The Service Verification Tests (SVT) must never be performed when the ventilator is connected to a patient and therefore require specific and deliberate action on the part of the technician to enable them.

The SVT incorporates all the features of the Special Functions and UVT capabilities as explained in the TBird Operator's Manual (P/N L1331) and adds the following features:

- 1. Manual Turbine Control. The Turbine can be controlled in terms of:
 - a) RPM
 - b) Flow
 - c) Pressure
- 2. Manual Oxygen Percentage Control
- 3. Manual Solenoid Control:
 - a) Auto Zero solenoids
 - b) Oxygen Blender solenoids
 - c) Inspiratory Hold Solenoid

November 1996 Service Manual

- 4. Transducer Calibration:
 - a) Turbine Differential Pressure Transducer
 - b) Exhalation Differential Pressure Transducer
 - c) Airway Pressure Transducer
 - d) Oxygen Blender Pressure Transducer
- 5. Entry of turbine serial number:
 - a) Ensures that the proper turbine characterization information is being utilized for accurate delivery of pressure and flow.
- 6. Watch Dog Test:
 - a) This function forces a software malfunction and tests to see if it is properly handled.

These abilities allow simulation of a wide variety of situations and with the monitoring of transducer information can be a valuable troubleshooting tool.

Performing The SVT

To perform the SVT, you must access the inside of the ventilator. This is intended for use by a Bird Factory Trained technician. Additionally, it requires the use of test equipment whose accuracy is known and that have been recently calibrated. If the test equipment is not available, the unit should be returned to Bird Products for proper calibration.

- Place the On/Standby switch to the Standby position. Refer to the Removal and Replacement section of this manual for removal of the sides and top of the ventilator.
 - 2. Locate DIP Switch 1 on the Main PCBA.

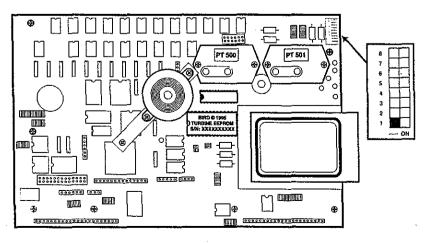


Figure 3-1. Main PCBA

- 3. Place DIP Switch 1 in the ON position. This is towards the inside of the ventilator as shown in Figure 3-1.
- 4. Turn the ventilator ON.

After the ventilator completes the Power On Self Test, the **Monitor Window** will display SUT ON.



When the SVT is entered, the audible alarm will be automatically enabled to alert the operator that this mode is being activated. Alarm Silence must be pressed to cancel the alarm.

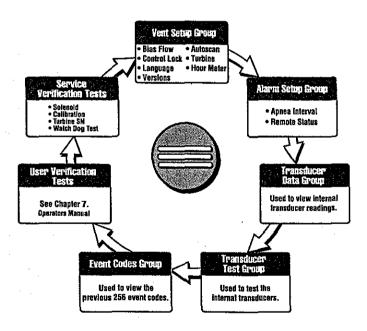


Figure 3-2. Special Functions Groups

Service Manual November 1996 3 - 3

As shown in Figure 3-2, all of the basic features of special functions and UVT are available. Rotating the *Set Value Knob* will display the available options in the **Monitor Window**:

SUT ON

UENT SETUP

ALARM SETUP

XDCR DATA

XDCR TESTS

EVENTS

MO TUU

While the ventilator is in the SVT mode, three or four control panel displays will be illuminated depending on the unit model.

The Tidal Volume display represents the RPM of the turbine. It may be changed by first pressing the button below the display and rotating the *Set Value Knob*.

The Peak Flow display represents the output of the turbine in LPM. This may be adjusted in the same way as the RPM.

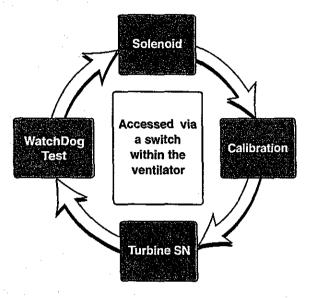
The PEEP/CPAP window represents the pressure in the patient circuit and is developed by the control of the Exhalation Valve. This may be adjusted in the same way as the RPM. However, to see any pressure developed in the patient circuit, some flow value or turbine speed must be entered first.

With the VSO₂/AVS, the Oxygen Percentage window will be illuminated. Oxygen percentage may be set at any time some flow value and turbine speed has been activated.

While the turbine speed, turbine flow, or circuit pressure are being manually controlled, the pressure transducers may be monitored by selecting XDCR DATA and selecting the appropriate transducer. This may be useful in determining if there is a malfunction of the unit. Refer to the troubleshooting section of this manual for further information.

5. Rotate the Set Value Knob until SUT ON is displayed in the Monitor Window.





Note: During the SVT, Tidal Volume controls turbine RPM, Peak Flow controls turbine flow, PEEP/CPAP controls circuit pressure, and %O2 controls the blender.

Figure 3-3. SVT (Service Verification Test)

Figure 3-3 shows the tests available when SVT is accessed within the special functions. Rotating the set value knob will display the available options in the monitor window.

Solenoid Test

- 1. Press the Select Key. The Monitor Window will display SOLENOID.
- 2. Press the Select Key.

Rotating the *Set Value Knob* will display the solenoids by name in the **Monitor Window**. When the *Select Key* is pressed, the solenoid selected will toggle between OFF (inactive) and ON (activated). Refer to Figure 3-4 for the solenoid being tested.

Service Manual November 1996 3 - 5

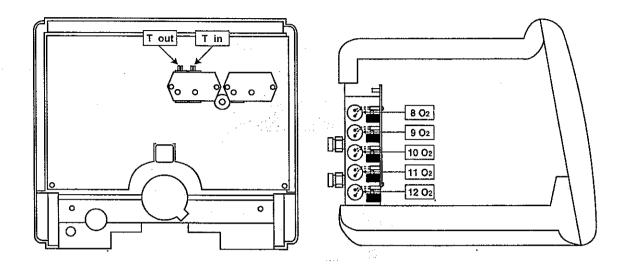


Figure 3-4. Solenoid Test

0 OCC OFF	CC OFF Inspiratory Hold Valve (AVS only)	
4 T OUT OFF	Turbine Outlet Auto Zero Solenoid	
5 T IN OFF	Turbine Inlet Auto Zero Solenoid	
6 XPRES OFF	Airway Pressure Auto Zero Solenoid	
8 02 OFF	Blender Solenoid, TBird™ VSO₂ and AVS	
9 02 OFF	Blender Solenoid, TBird™ VSO₂ and AVS	
10 02 OFF	Blender Solenoid, TBird™ VSO₂ and AVS	
11 02 OFF	Blender Solenoid, TBird™ VSO₂ and AVS	
12 02 OFF	Blender Solenoid, TBird™ VSO₂ and AVS	
13 02 OFF	Not Used	

3. Press the Set Value Knob to display SOLENOID in the Monitor Window.

Calibration

Rotate the Set Value Knob until Monitor Window displays CALIBRATION.



If you enter calibration within the first 60 seconds of ventilator operation, a waiting message will be posted. Once the waiting message clears, you may proceed with calibration.



WARNING



The procedure for calibrating the Exhalation Differential Transducer requires the use of external pressure sources and external pressure monitoring. Do not select this test unless the required equipment is available. External values applied during these tests will change internally stored information in the ventilator. Performance and accuracy will be affected if external test equipment is not of the specified accuracy.



Note

During the calibration process, the manual control of the Turbine and Blender will be inhibited. This is indicated by the display of **OFF** in their display windows.

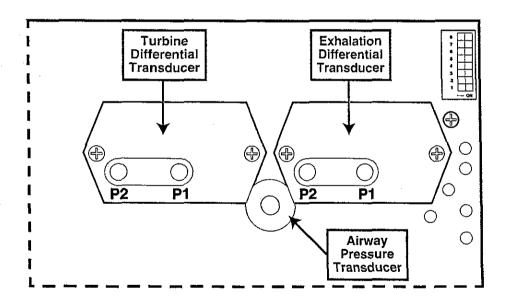


Figure 3-5. Airway Pressure Transducer

Airway Pressure Transducer Calibration

Press the Select Key. The Monitor Window will display XPRES.

Referring to Figure 3-5, disconnect the tubing from the Airway Pressure Transducer.

- Press the Select Key and the Monitor Window will display XPRES 0.
- 3. Press the *Select Key* to enter this value to ventilator memory and to advance the monitor display to read XPRES 60.
- 4. Connect an external source of 60 ± 0.6 cmH₂O to the Airway Pressure Transducer.
- Press the Select Key to enter this value to ventilator memory.

If the values are within tolerance, the **Monitor Window** will display XCAL DK.

If the monitor display reads XCAL NOT OK, repeat the calibration with attention to the applied pressure.

To store the new calibration values in memory, press the Select Key. To ignore the new value, press the Set Value Knob.

Referring to Figure 3-5, replace the original tubing to the Airway Pressure Transducer.

Turbine Differential Pressure Calibration

1. Press the Select Key and the Monitor Window will display TDIFF.

Referring to Figure 3-5, remove the two (2) tubes from the Turbine Differential Transducer.

- 2. Press the Select Key and the Monitor Window will display TDIFF 0.
- Press the Select Key to enter this value to ventilator memory and to advance the Monitor Display to read TDIFF 68.



CAUTION A



Double check the pneumatic connection to the TDIFF transducer before applying pressure. If the 60 cmH₂O pressure is inadvertently applied to the X DIFF transducer it will be permanently damaged and require replacement.

Referring to Figure 3-5, connect an external source of 60 ± 0.6 cmH2O to the P2 port on the Turbine Differential Transducer.

To store the new calibration values in memory, press the *Select Key*. To ignore the new value, press the *Set Value Knob*.

If the values are within tolerance, the Monitor Window will display TCAL OK.

If the Monitor Display reads TCAL NOT CK, repeat the calibration with attention to the applied pressure.

4. Replace the original tubing to the Turbine Differential Transducer.

Exhalation Differential Transducer Calibration

- 1. Press the Select Key and the Monitor Window will display XDIFF.
 - Referring to Figure 3-5, remove the two (2) tubes from the Exhalation Differential Transducer.
- 2. Press the Select Key and the Monitor Window will display XDIFF 8.
- 3. Press the *Select Key* to enter this value to ventilator memory and to advance the Monitor Display to read XDIFF 3.
- 4. Connect an external source of 3 ± 0.03 cm H_2O to the P2 port on the Turbine Differential Transducer.
- 5. To store the new calibration values in memory, press the *Select Key*. To ignore the new value, press the *Set Value Knob*.

If the values are within tolerance, the Monitor Window will display FCAL OK.

If the Monitor Window reads FCAL NOT $\,$ OK, repeat the calibration with attention to the applied pressure.

6. Replace the original tubing to the Exhalation Differential Transducer.

Oxygen Pressure Transducer Calibration

1. Press the Select Key and the Monitor Window will display 02 CAL.

- 2. If oxygen is connected to the unit, turn off the pressure and disconnect it from the ventilator. Using a small screwdriver or similar tool, momentarily open the check valve in the O_2 inlet fitting to insure that any residual pressure is released.
- 3. Press the Select Key and the Monitor Window will read 02 0.
- 4. Press the *Select Key* to store the 0 pressure point in memory.

The **Monitor Window** will now read 02 50.

- 5. Attach a known 50 ± 0.1 psi source to one of the O_2 fittings at the rear of the ventilator.
- 6. Press the Select Key to store the 50 psi pressure point in memory.

Turbine Serial Number Entry

1. Press the Select Key and the Monitor Window will display TURBINE SN.



Note

Prior to performing the following procedure, record the serial number from the EEPROM supplied with the Turbine and the serial number from the label on the turbine.

Press the Select Key and the Monitor Window will be blanked. The serial
number from the Turbine may now be entered by turning the Set Value Knob to
the value desired. When the first digit is displayed, press the Select Key to
advance to the second digit. Upon entry of the last digit, the unit will exit the
entry mode.

Watch Dog Test

1. Rotate the Set Value Knob and the Monitor Window will display MD06 TEST.



Note

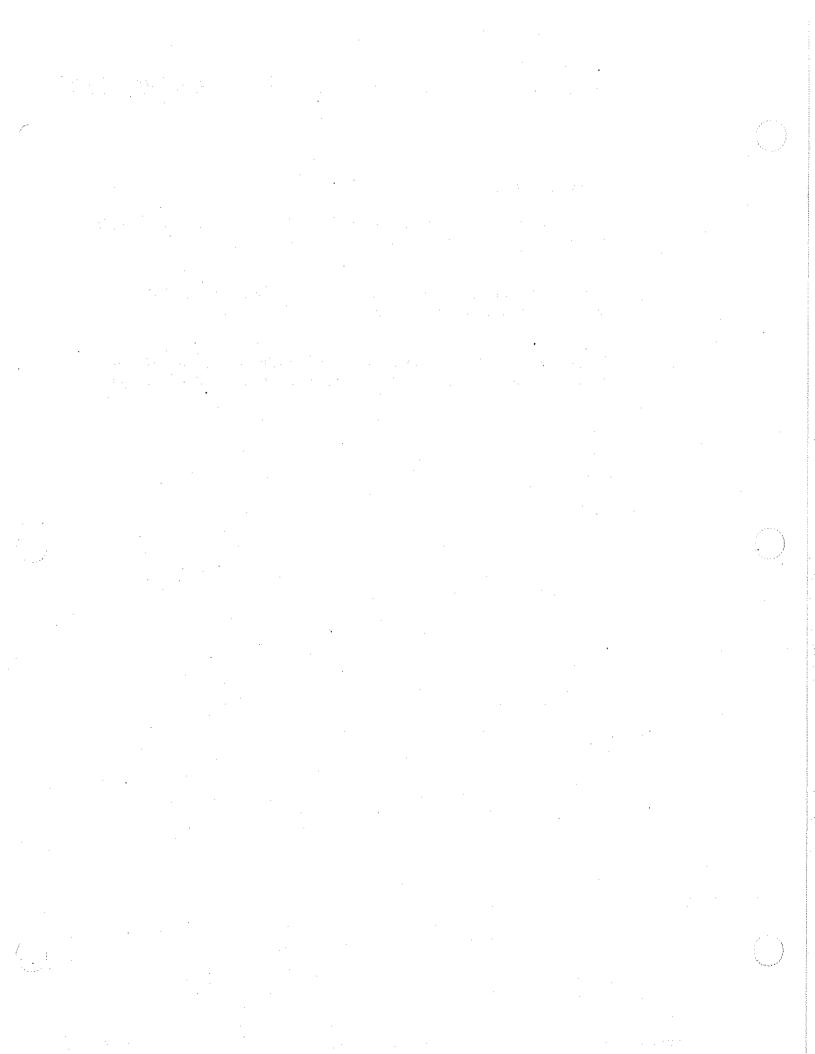
The Watch Dog test simulates an actual event that would take place if a malfunction of the microcomputer system had occurred. Consequently the results of this test will force the ventilator into a VENT INOP state. The only way to recover from this is to turn the ventilator off and back on again.

2. Press the Select Key.

The unit will go into an INOP state, all displays will be blank, the Vent Inop LED will be illuminated, and a steady audible tone will be generated.

3. Place the **On/Standby** switch in the Standby position and press the **Alarm Silence** key to silence the audible alarm.

To repeat any of the Special Functions, place the unit in the On position. If you are finished, restore DIP switch 1 to the off position and replace the covers on the unit.



CHAPTER 4 — TECHNICAL TROUBLESHOOTING

Monitor Window Messages

This section of the service manual provides symptoms, definitions, and suggestions for the correction of problems that may be reported with the TBird Ventilator.

In all cases, the technician should first ensure that the ventilator is being used properly to eliminate any possible operator related problems.

When a problem is reported, all available information should be obtained as to ventilator settings, the type of patient circuit being used, the patients condition, and the details of the reported malfunction.

If the ventilator has been recently serviced, particularly if the covers have been removed for any reason, check all electrical and pneumatic connections for proper installation and orientation. Often a marginal connection may not show up immediately.

The first series of messages are those that the ventilator may display in the Monitor Window as a result of initial Power On Self Tests or those messages that are generated as a result of continuous monitoring while the ventilator is in operation.

Display	Page
APNEA	4-2
BATTERY ON	4-2
CHECK BKUP	4-2
CHECK EVENTS	4-2
CIRC FAULT	4-3
DEFAULTS	4-3
DPRAM 1	4-3
DPRAM 2	4-3
EEPROM FAULT	4-3
EXT BATTERY	4-3
FAN FAULT	4-4
FILTER	4-4
FLASH UPDATE	4-4
FLOW CAL	4-5
FLOW SENSOR	4-5
HIGH O ₂	4-6
HIGH PEEP	4-6
HIGH PRES	4-6
HW FAULT	4-7
IOP CPU	4-7
IOP DPRAM	4-7
IOP IRAM	4-7

Display	Page
IOP RAM	4-7
IOP ROM	4-7
IOP TIMER	4-7
IOP XRAM	4-7
LIMITED	4-7
LOCKED	4-8
LOW BATTERY	4-8
LOW O ₂	4-8
LOW PRES	4-8
LOW VOLUME	4-9
NEW SENSOR	4-9
NO CAL DATA	4-9
POWER UP	4-9
RELEASE IOP	4-9
REMOTE FAULT	4-9
ROM 1	4-9
SRAM	4-10
TIMER	4-1(
TURBINE ROM	4-10
WATCHDOG PAL	4-10
XDCR FAULT	4-10

Monitor Window	Description	Suggestion
îPNEî:	Time between detected inspirations has exceeded the set Apnea Interval.	 Evaluate patient status. Verify that Apnea Interval is at appropriate setting. Verify Sensitivity setting. Perform Auto-Zero on Transducers. Check/replace Flow Transducer.
BATTERY ON	 Operating on Battery Power (Internal or External Battery). This will occur if: AC power has been lost from the ventilator. Internal wiring has become disconnected. A power supply malfunction is simulating an AC loss. 	 Check power cord for secure connections. Check fuse(s). Check wall AC receptacle. Check all internal connections associated with AC. (See Chapter 6, Schematics, of this manual.) Replace power supply with a known functional unit.
CHECK BKUP	Ventilator has powered up in CPAP Mode or CPAP Mode is selected.	Verify that Apnea Back Up ventilation parameters are appropriately set.
CHECK EVENTS	Errors have been detected forcing a machine reset. This is a prompt to investigate which events caused this to occur.	 Check the definition of the stored event codes as described in Appendix G of the TBird Operator's manuals and perform suggested remedies. Contact Bird Certified Service Technician.

Monitor Window	Description	Suggestion
CIRC FAULT	This may be caused by one of the following circumstances:	
	The turbine differential pressure has exceeded the High Pressure Limit setting by an excessive amount.	 Check for occlusions of the patient circuit. Check the pressure transducers for possible drift.
	2. A flow rate of 150 LPM has persisted for > 2 seconds.	Check for a disconnect in the patient circuit.
sa Service de Lace	A problem exists with one of the internal transducers.	 Check the pressure transducers for possible drift. Check the transducer for possible drift.
DEFAULTS	This will occur as an intended operation when the program memory or configuration memory cards are installed.	Enter desired ventilator parameters.
	It may also occur when ventilator parameters have reverted to internally stored values. EEPROM memory has been corrupted or is no longer functional.	 Enter desired ventilator parameters. Replace Main PCBA.
DPRAM 1	POST detected a failure of the Dual Port Random Access Memory.	1. Replace Main PCB.
DPRAM 2	POST detected a failure of the Dual Port Random Access Memory. Data read does not match data written.	1. Replace Main PCB.
EEPROM FAULT (Alert)	EEPROM that stores ventilator settings will not accept additional information.	1. Replace Main PCBA.
EXT BATTERY	Battery power has switched from the optional external battery to the internal battery.	 Check that the external battery is connected securely. Replace external battery with one which has been recently fully charged.
	•	3. Connect the unit to AC power.

Monitor Window	Description	Suggestion
FAN FAULT	Continuous ventilator status monitoring has detected that the cooling fan has stopped or is rotating at an unacceptably low rate of speed.	 Check to see that there is nothing preventing or interfering with the fan's rotation. Check the electrical connection from the fan to the Power Supply PCBA. Replace the fan assembly.
FILTER (Alert)	This alert appears when the ventilator hour meter is on even multiples of 500 as a reminder to check the inlet filters on the ventilator.	 Clean or replace air inlet filter. Pressing SELECT will clear this alert. However, if the ventilator is placed in standby and turned back on while the hour meter is still a multiple of 500, it will reappear.
FLASH UPDATE	This is a normal message that is displayed when software changes are installed.	
	It may also result if a comparison of the Configuration Memory Card and the IOP Flash Memory finds differences. An update will be attempted and if a difference is found again, the unit will be forced into an INOP state.	 Replace Configuration Memory Card. Replace Main PCB.

Monitor Window	Description	Suggestion
FLON CAL (Alert)		Perform a Manual Flow Cal Indicates a valid Flow
		Calibration has not been performed. This alert occurs when the Ventilator is Powered up.
	Internal or external leaks may be preventing a valid Flow Cal.	Check for leaks in the patient circuit.
		Check internal tubing to the Exhalation Pressure Transducer.
	Pressure Transducers may be out of calibration.	Perform Pressure Transducer calibrations as described in the SVT chapter of this manual.
FLOW SEMSOR (Alert) (TBird AVS only)	Ventilator cannot detect the presence of an AVS Exhalation Valve Body.	Verify that Exhalation Valve is correctly labeled as an AVS Valve Body. Installing a VS/VSO2 Valve body will cause this alert.
	TIRIS module is not operating correctly.	 Reseat Exhalation Valve Body. Replace Exhalation Valve Body Contact Bird Certified Service Technician.

Monitor Window	Description	Suggestion
HIGH 02 (TBird AVS and VSO ₂ only)	Oxygen inlet pressure has risen above 65 psi. (This only occurs when FIO ₂ is set above 21% or 100% O ₂ 3 Min has been activated.)	 Reduce O₂ supply pressure below 65 psi. Check calibration of O₂ Pressure Transducers described in the SVT chapter of this manual. Replace Blender PCB.
HIGH PEEP	Pressure in the patient circuit is not returning to within +15 cmH ₂ O of the PEEP setting after an inspiration.	 Check patient circuit for occlusion in the expiratory leg. Check exhalation manifold for proper assembly and patency of the exhalation diaphragm. Check transducer calibration. Replace exhalation valve body. Replace exhalation valve.
HIGH PRES	The ventilator has attempted to exceed the High Pressure Alarm Setting.	 Evaluate patient status. Evaluate setting of High Pressure Alarm. Check for conditions with the patient circuit which may have decreased compliance. Verify that front panel settings have not been changed. Perform transducer calibration procedures as described in the SVT chapter of this manual.

Monitor Window	Description	Suggestion
HN FAULT	This indicates that continuous monitoring has detected a Hardware Fault. This indicates one of two conditions:	
	A DAC on the Main PCB has failed its self test. The Event Code 250 will be stored.	1. Remove the ventilator from its current location and attempt operation in a different environment to eliminate external causitive factors. If the problem persists, the Main PCBA is suspected to be malfunctioning.
	2. An over temperature condition has been detected on the Power Supply. The Event Code 251 will be stored.	 Check that the fan filter is not occluded and that the fan is operating. Check that the thermistor attached to the Power Supply has not been damaged. Replace the Power Supply.
IOP CPU IOP TIMER & IOP RAM	POST detected that the IOP programmed operation, timers, or internal RAM has failed.	1. Replace Main PCB.
IOP OPRAM	During POST the IOP has found that it cannot correctly access DPRAM.	1. Replace Main PCB.
IOP ROM	During POST the IOP program memory was found to be different from flash memory. Checksum test failed.	1. Replace Main PCB.
IOP XRAM	During POST an error has been detected in the testing of the extended memory area used by the IOP (AVS only).	1. Replace the Main PCBA.
LIMITED (Alert)	Operator is attempting to set ventilator controls that conflict with each other.	 Evaluate the settings of the control being changed with relation to the ones that are flashing.

Monitor Window	Description	Suggestion
LOCKED (Alert)	Operator has attempted to change a control setting while the ventilator has Control Locks on.	 Press the Set Value Knob to release the locking function. Change Control Locks status in the Special Functions.
LOW BATTERY	Power remaining in the internal battery has dropped to medium capacity. This is accompanied by an intermittent audible alert and may be reset. OR:	
	Power remaining in the internal battery has dropped to low capacity. This is accompanied by a continuous audible alarm and cannot be reset.	 Connect ventilator to a source of AC power. Connect ventilator to an external battery. Remove unit from service until internal batteries can be checked or replaced. Check wiring from the internal batteries to the Power Supply for secure connection.
LOW 02 (TBird AVS and VSO ₂ only)	Oxygen inlet pressure has fallen below 35 psi. (This only occurs when FIO ₂ is set above 21% or 100% O ₂ 3 Min has been activated.)	 Increase O₂ supply pressure to above 35 psi. Check calibration of O₂ Pressure Transducer. Replace Blender PCB.
LOW PRES	The ventilator has failed to exceed the setting of the Low Peak Pressure alarm.	 Evaluate patient status. Check patient circuit and exhalation valve body for leaks. Evaluate the setting of the Low Peak Pressure alarm. Verify that front panel settings have not been changed. Perform transducer calibration
		procedures as described in the SVT chapter of this manual.

Monitor Window	Description	Suggestion
LOM VOLUME	Measured exhaled volumes have fallen below the Low Minute Volume setting.	 Evaluate patient status. Verify that the front panel settings have not been changed. Check for leaks in the patient circuit and exhalation valve body. Verify the delivered volumes as shown in the procedure at the end of this chapter.
NEW SENSOR (Alert) (T-Bird AVS only)	New AVS Exhalation Valve Body has been detected.	This is a normal function when a new valve is detected. If alert persists for more than one minute, treat the same as the Flow Sensor Alert.
NO CAL DATA (Alert)	Stored transducer calibration data does not match validation code stored in EEPROM.	 Perform transducer calibration procedures as described in the SVT chapter of this manual. Replace Main PCB.
POWER UP	POST detected a malfunction in the MSP.	 Verify proper software installation. Replace software. Replace Main PCB.
RELEASE IOP	During POST the IOP has failed to initiate program instructions after being allowed to do so.	1. Replace Main PCB.
REMOTE FAULT	Malfunction of the Remote Alarm PCB. Information from internal remote alarm module is absent or invalid. (Remote alarm must be enabled.)	 Replace the Remote Alarm PCB. Check internal cable for proper connection. Replace the Remote Alarm PCB.
ROM 1	During POST an error has been detected in the MSP Program Memory (configuration memory card). CRC check failed.	 Replace the Program Memory Card with one known to be functional. Replace Main PCB.

Service Manual

Monitor Window	Description	Suggestion
SRAM	POST has detected a failure in the Static Random Access Memory.	1. Replace Main PCB.
TIMER	POST has detected a failure in the hardware timers that generate interrupts for the MSP.	1. Replace Main PCB.
TURBINE ROM	An error has been detected in the calibration data memory of the turbine EEPROM. Checksum test failed.	Replace Turbine and Turbine EEPROM.
MATCHDOG PAL	POST has detected a failure in the Watch Dog circuitry.	1. Replace Main PCB.
XDCR FAULT	A manual or automatic auto-zero of a transducer has been performed and it is outside of defined limits or a transducer has drifted in output.	_ • • • •
		7. If the XDCR DATA indicates the patient circuit pressure transducer is malfunctioning, the Main PCBA must be replaced.

Event Detection Codes

The Event Codes are software routines that are constantly monitoring the operation of the ventilator. If these routines detect an anomalous condition or result of some function, this code records that occurrence to assist in determining what occurred and when it occurred.

Individual occurrences of events may not be significant as they can be generated by external influences and may not affect the operation of the ventilator. Repetitive occurrences may indicate the need for investigation of the problem.

There are 4 general causes for these codes to be generated:

System Monitoring

There are some codes which do not indicate a problem has occurred but reflect changes in ventilator status. These codes are meant to indicate points in time that may be useful in determining a problem should it happen after one of these events. Examples of these are:

- 64 Ventilator has powered up
- 67 Ventilator has switched from AC to battery power
- 68 External battery alert occurred
- 69 Internal battery alert occurred

Environmental

Environmental conditions are external to the ventilator and exceed established standards. In some cases these may influence the operation of the ventilator. Examples of these include:

- EMI (Electro-Magnetic Interference)
- RFI (Radio Frequency Interference)
- ESD (Electro-Static Discharge)
- AC electrical supplies
- Temperature
- Inadequate or erratic oxygen supplies (VSO₂/AVS only)

Environmental conditions are the easiest to eliminate and do not require the intervention of a biomedical technician. The course of action would be to move the ventilator a distance from the location where the problem occurred, use a different AC outlet, or use a different source of oxygen. If the problem is eliminated there is a good possibility that there was some external factor involved.

Hardware

A hardware condition would be a mechanical or electronic problem internal to the ventilator. Examples include:

- Loose or improperly positioned electrical connections
- Leaks or misplacement of internal pneumatic connections
- Malfunctioning pneumatic or electronic components within the ventilator

These would require more in-depth investigation and the assistance of a Bird Factory Trained technician.

Software

Due to the extensive processes in the creation, validation, and testing of software, and the continuous self checking that the ventilator performs, this type of situation is the least likely to be the basis of a problem. The previously discussed causes must be eliminated prior to pursuing a problem with the software used in the ventilator.

If a software problem is suspected, it must be reported to Bird Products Corporation along with all of the circumstances of the occurrence. This will enable a Bird technician to evaluate the situation and suggest possible corrective action.

Refer to Appendix G of the TBird Operator's Manuals for an explanatory list of event codes.

General Malfunctions

The following table is concerned with General Malfunctions. In all cases, first be certain that the unit is being operated properly and that the patient circuit and exhalation valve body/diaphragm are properly assembled and not damaged.

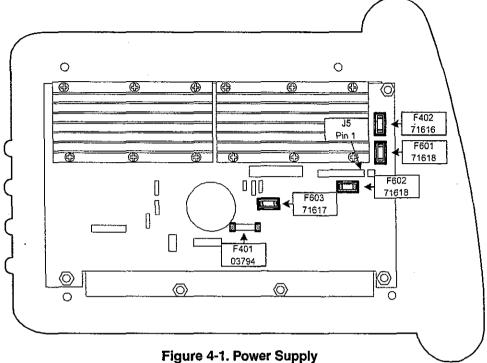
Symptom Suggestions	
Oxygen concentrations are high. (VSO ₂ /AVS only)	·
	2. A solenoid on the blender may be leaking or stuck open. Remove blender from ventilator and apply 40-60 psi O ₂ . Check for flow coming out of the blender outlet.
	3. Check the output flow of the turbine as described in Chapter 3 of this manual, Service Verification Tests, using the manual controls of the turbine. Low flow would indicate a need for turbine replacement.
	4. Replace blender.
Oxygen concentrations are low. (VSO ₂ /AVS only)	Perform blender transducer calibration as described in Chapter 3 of this manual.
	 A solenoid on the blender may not be opening or the drive circuitry may be malfunctioning. Check individual solenoid by manually opening each solenoid as described in Chapter 3 of this manual, Service Verification Tests.
	Check the output flow of the turbine as described in Chapter 3 of this manual using the manual controls of the turbine. High flow would indicate a need for turbine replacement.
	4. Replace blender.
Blender does not operate. (VSO2/AVS only)	 Check cable from main PCBA to blender for proper connection and integrity. Replace blender.
Monitored exhaled	Check for patient circuit leaks.
volumes are low	2. Check the setting of the over pressure relief valve.
	Check passages in exhalation valve body for occlusion.
	4. Ensure that a valid Flow Cal has been performed.
	5. Replace exhalation valve body with a known functional unit.
	6. Perform exhalation differential pressure transducer calibration.

Symptom	Suggestions		
Monitored exhaled volumes are high	 This is normal when oxygen is introduced to the TBird VS. Evaluate Tidal Volume settings. 		
	2. Perform Flow Cal procedure as described in the TBird Operator's Manuals.		
•	3. Check passages in exhalation valve body for occlusion.		
	 Replace exhalation valve body with a known functional unit and reevaluate Tidal Volume settings. 		
	Perform transducer calibration procedures as described in Chapter 3 of this manual.		
Delivered volumes are high	This is normal when oxygen is introduced to the TBird VS. Evaluate Tidal Volume settings.		
	2. Perform transducer calibration procedures as described in Chapter 3 of this manual.		
	3. Replace turbine assembly.		
Delivered volumes are low	1. Check for leaks in the patient circuit, humidifier, or water traps.		
	2. Check the setting of the Over Pressure Relief Valve.		
	3. Check the exhalation valve body and diaphragm for mechanical integrity and proper installation.		
	4. Perform transducer calibration procedures as described in Chapter 3 of this manual.		
	5. Replace turbine assembly.		
Sensitivity appears to be inaccurate or erratic	Perform Flow Cal procedure as described in the TBird Operator's Manuals.		
	2. Check for leaks in the patient circuit.		
	3. Replace exhalation valve body and diaphragm.		
: 	 Perform transducer calibration procedures as described in Chapter 3 of this manual. 		

Symptom	Suggestions		
Unit is auto-triggering	Perform Flow Cal procedure as described in the TBird Operator's Manuals.		
	2. Check patient circuit for leaks.		
	3. Check the setting of the over pressure relief valve.		
	4. If a test lung is being used, ensure that there is at least $5 \text{ cmH}_2\text{O/L/Sec}$ resistance.		
	5. Check the exhalation valve body and diaphragm for proper installation and condition.		
	6. Perform transducer calibration procedures as described in Chapter 3 of this manual.		
High and low pressure alarms do not seem to be accurate.	 Perform transducer calibration procedures as described in Chapter 3 of this manual. Replace the Main PCB. 		
Peak flow does not seem to be accurate.	 Perform transducer calibration procedures as described in Chapter 3 of this manual. Replace the turbine assembly. 		
A key or keys on the control panel do not appear to be functional.	 Check the keypad functions using the UVT procedure in the TBird Operator's Manuals. Check the ribbon cables from the control panel to the Main PCB for secure connections. Replace the control panel. 		
The ON indicator on the front panel illuminates red when the Power Switch is turned on. Ventilator is inoperative.	 This indicates a loss of some power supply voltage. Check all of the connectors to the power supply for secure connections. Check the fuses on the power supply PCB Check the power supply voltages per the diagram in the back of this section. Replace the power supply. Replace the main PCB. 		

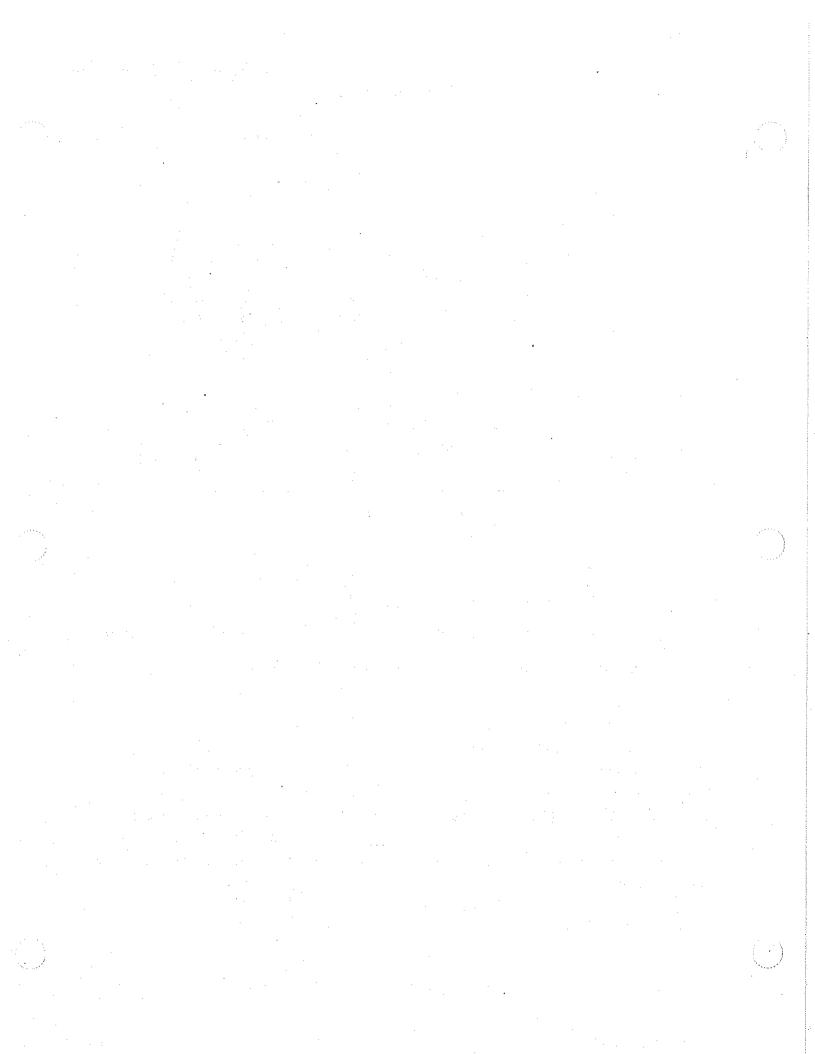
Symptom	Suggestions		
The ON indicator on the front panel illuminates amber (yellow) when the Power Switch is turned on. Ventilator is inoperative.	 This indicates that the ventilator is not detecting a Program Memory card installed. Install a known functional Program Memory Card. Insure that the Program Memory Card is plugged into the rear slot and is securely seated in the receptacle. Check for damage to the pins in the card receptacle. 		
Either the Internal or External Battery Charge Indicator is illuminated red and remains red for > 24 hours.	 This indicates that one or both battery sets is not able to accept a charge and will not power the ventilator. Check the fuse on the power supply. If it is open this may occur. Replace the malfunctioning battery set with one that is known to function. 		

Power Supply Voltage Check



- 1. Locate connector J5.
- 2. Remove the white strain relief cap from the connector.
- 3. Connect the DVM ground to the ground stud on the rear panel of the ventilator.
- 4. Verify the voltages in accordance with the following table:

<u>J</u> 5	Voltage		
Pin 1	$+5 \text{Vdc} \pm 6\% (4.7 - 5.3 \text{Vdc})$		
Pin 2	+5 Vdc ± 6% (4.7 - 5.3 Vdc)		
Pin 3	Ground	Pin 10	+48 Vdc ± 6% (49.12 - 50.88)
Pin 4	+8 Vdc ± 6% (7.52 - 8.48 Vdc)	Pin 11	Ground
Pin 5	+8 Vdc ± 6% (7.52 - 8.48 Vdc)	Pin 12	+48 Vdc ± 6% (49.12 - 50.88)
Pin 6	Ground	Pin 13	Int S+ (N/A-Internal Battery Sense)
Pin 7	+24 Vdc ± 6% (24.56 - 25.44 Vdc)	Pin 14	Ext S+ (N/A-External Battery Sense)
J5	Voltage		
Pin 8	+24 Vdc ± 6% (24.56 - 25.44 Vdc)		
Pin 9	Ground		



CHAPTER 5 - REMOVAL AND REPLACEMENT

What This Chapter Describes

This section of the TBird V entilator Series Ser vice Manual deals with the procedures for parts replacement within the TBird ventilator .

Tools Required:

- Common Screwdriver
- Phillips Cross-tip Screwdriver
- Common Pliers
- Needle Nose Pliers
- Anti-Static W rist Strap
- Integrated Circuit Removal Tools
- Thin Walled 11/32" Socket or Nut Driver

In most cases, reassembly is simply a reversal of the disassembly process. If there are any special instructions they will be added at the end of the removal process.

The following WARNINGS and CAUTIONS should be read and understood before accessing the interior of the ventilator:



WARNING



Electrical shock hazards are present within the ventilator even after AC power has been removed. It is recommended that the top cover be electrically unplugged to disconnect the batteries from the ventilator.



CAUTIONS A



Appropriate measures to prevent ESD damage to electronic components must be taken:

- Wear a properly grounded and tested anti-static wrist strap when handling PCB's.
- Work on an anti-static surface.
- Always use anti-static material for packaging PCB's.

Attached to the top cover of the ventilator is a large energy storage capacitor that may have some residual charge. Use extreme care not to allow any conductive material to contact the electrical connections.

5 - 1 Service Manual November 1996

REMOVAL AND REPLACEMENT

Table of Contents

Part	Page
7 Segment Red Display	547
7 Segment Yellow Display	5-17
Alarm Loudness Potentiometer	5-24
Anti-Suffocation Valve	5-26
Base Plate O-Rings	5-26
Blender Assembly	5-21
Configuration Memory Card	. 5-6
Control Panel	5-15
Display PCBA	5-15
Dot Matrix Displays	
EMI/RFI Filter	. 5-24
Energy Storage Capacitor	. 5-10
Exhalation Differential Pressure Transducer	. 5-25
Exhalation Valve	. 5-19
External Docking Bay	. 5-28
Fan Assembly	. 5-22
Fan EMI Filter	. 5-22
Fan Inlet Filter	. 5-22
Front Panel	. 5-14
Fuse Holder	. 5-24
Internal Batteries	. 5-10
Main PCBA	. 5-15
Motor Controller PCBA	. 5-12
Muffler/Filter Core Assembly	. 5-18
Outlet Check Valve Assembly	. 5-27
Overlay	. 5-15
Panel Encoder Assembly	
Patient Assist Call	. 5-23
Power Supply Removal	
Program Memory Card and Configuration Memory Card	
Protective Cover Removal	5-8
Relief Valve Assembly	
Socketed LED	
Standby/On Switch	
Top Cover	
Turbine Assembly	. 5-20
Turbine Differential Pressure Transducer	
Ventilator Left and Right Side Cover Removal	
Watch Dog PAL	5-13
Wire Harness and Cable Assemblies	534

Ventilator Left and Right Side Cover Removal

For most removal and replacement operations, the covers must be removed from the ventilator. Note that it is necessar y to remove the left and right side covers before the removal of the top cover can be accomplished.



Prior to cover removal, disconnect AC power from the wall source and ensure that the Standby/On Switch is in the Standby Position.

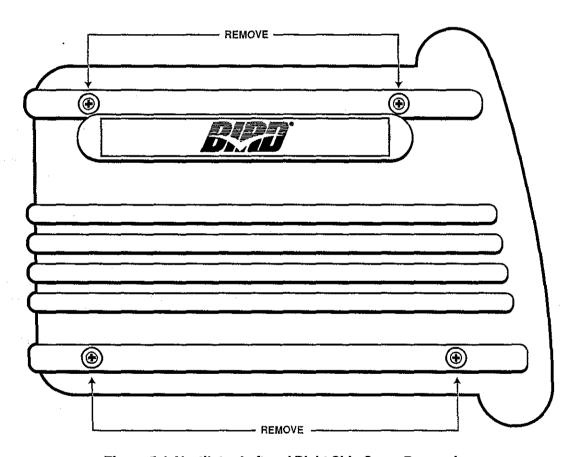


Figure 5-1. Ventilator Left and Right Side Cover Removal

Left Side Cover

- 1 Referring to Figure 5-1, use a Phillips screwdriver and remove the four (4) screws securing the left side cover .
- 2 Remove the left side cover and set aside.

Ventilator Left and Right Side Cover Removal (Continued)

Right Side Cover



A CAUTION A



The Power Supply is mounted to the right side cover of the ventilator. Removal must be done carefully to insure that wire harnesses are not strained and that the Power Supply components are not allowed to contact electrically conductive materials of the ventilator including the shield coating on the inside of the ventilator.

- 1 Using Figure 5-1 as a reference, remove the (4) Phillips screws securing the right side cover to the ventilator chassis.
- 2 Gently pull the right side panel away from the ventilator and set it on the work surface in a vertical position, leaning against the ventilator chassis.
- 3. Some insulating material may be used to hold the right side panel away from the chassis of the ventilator .



<u> WARNING</u>



Electrical shock hazards are present within the ventilator even after AC power has been removed. Pay particular attention to the large electrolytic capacitor mounted to the Top Cover.

Top Cover

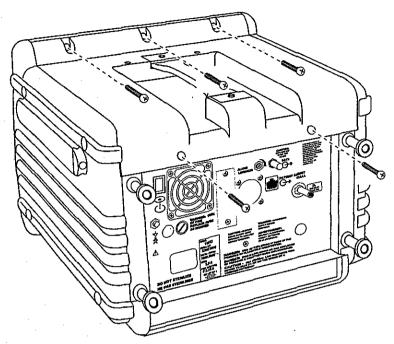


Figure 5-2. Top Cover Removal

- 1 Per form the procedure to remove the left and right side covers.
- 2. Referring to Figure 5-2, remove the three (3) screws from the top front of the ventilator.
- 3. Holding the top cover, remove the two (2) screws from the rear of the ventilator.
- 4. Lift the cover slightly in the rear and pull back and away from the ventilator
- 5. Set the ventilator cover on the work sur face at the rear of the ventilator
- Unplug the large white connector connected to the top cover , hold the locking tabs depressed and pull the opposite side of the connector . Set the top cover aside.

Program Memory Card and Configuration Memory Card



When handling the Program Memory Card or the Configurtion Memory Card and contacting the inside of the ventilator, precautions must be taken to avoid ESD damage. An anti-static wrist strap should be worn and correctly grounded while performing this procedure. At a minimum, always touch the copper colored coating inside of the chassis to equalize potential charges prior to placing the card in the ventilator.

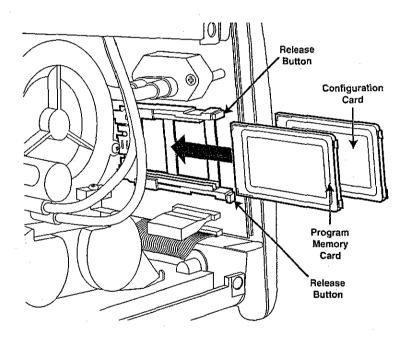


Figure 5-3. Program Memory Card and Configuration Memory Card

- Remove AC Power from the ventilator wall source.
- 2 Verify that the **ON/STANDBY** switch in the rear of the ventilator is in the **STANDBY** position.
- 3 Refer to the procedure for the removal of the left side cover of the ventilator
- 4 Referring to Figure 5-3, press the release button on the lower edge of the card receptacle to eject the Program Memor y Card. Note the orientation of the Program Memor y Card as it is removed from the ventilator.

Program Memory Card and Configuration Memory Card (Continued)

5 Referring to Figure 5-3, press the release button on the upper edge of the card receptacle to eject the Configuration Memor y Card. Note the orientation of the Configuration Memor y Card as it is removed from the ventilator.



Note

The Program Memory Card is installed in the rear card holder rails as viewed from the front of the ventilator. Installation in the front slot will do no damage but the ventilator will not operate and will show an amber/yellow illumination of the ON led on the front panel.



Note

The Configuration Memory Card is installed in the front card holder rails as viewed from the front of the ventilator. Installation in the rear slot will do no damage but the ventilator will not operate and will show an amber/yellow illumination of the ON led on the front panel.

- Insert the replacement Program Memor y Card in the rear slot with the label facing to the front of the ventilator and the arrow pointing up as shown on the label viewed from the front of the ventilator .
- Insert the Configuration Memor y Card in the front slot with the label facing to the front of the ventilator and the arrow pointing up as shown on the label viewed from the front of the ventilator .
- 3 Replace the left cover of the ventilator and perform the operational check as described in the TBird Operator's Manual.



Note

When the Program Memory Card contains a different version of software than was previously installed, the message FLASH UPDATE will be displayed in the monitor window as the parameters are read into the ventilators memory. Following this the ventilator will operate at default settings until new parameters are entered.

Protective Cover Removal

🖎 Note

If a left or right protective cover is being replaced, be aware that it is composed of two sections; the pliable outer portion and the inner reinforcing plate. The side rail assemblies are <u>NOT</u> included. These items have individual part numbers. See Chapter 7, Parts List, of this manual for details.

- 1 Remove the selected cover completely from the ventilator.
- 2 If the right protective cover is being replaced, follow the procedure for removal of the power supply.
- 3. Remove the side rail assembly .

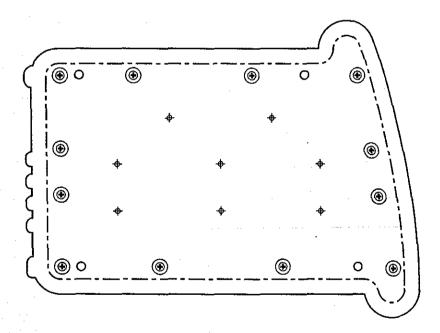
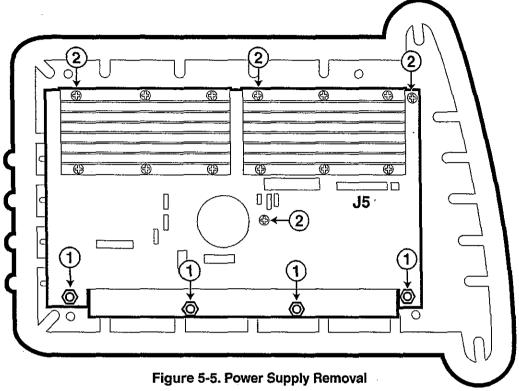


Figure 5-4. Protective Side Covers

- 4. Referring to Figure 5-4, remove the twelve (12) flat head screws from the reinforcing plate.
- 5 To separate the two por tions, peel the pliable cover away from the reinforcing plate.
- 6 To re-assemble, align the plate with the protrusions and pull them through using pliers and reverse the disassembly process.

Power Supply Removal (P/N 50590)



- 1 Per form the procedure for removing right cover from the ventilator
- 2 Remove the electrical connections to the Power Supply noting position and orientation.
- Referring to Figure 5-5, remove the four (4) nuts (Figure 5-5, ref. 1) and four (4) screws (Figure 5-5, ref. 2) securing the Power Supply to the to the right side cover.
- 4. Place the Power Supply in anti-static packaging for shipment.



Before assembling the ventilator, be sure to double check the alignment of connector J5. Misalignment of this connector can cause catastrophic damage to the Power Supply and/or the Main PCB.

5 To install the replacement Power Supply , refer to T able 5-1, at the end of this section, for electrical connections and reverse the removal process.

Internal Batteries (P/N 68093)

Energy Storage Capacitor (P/N 64084)

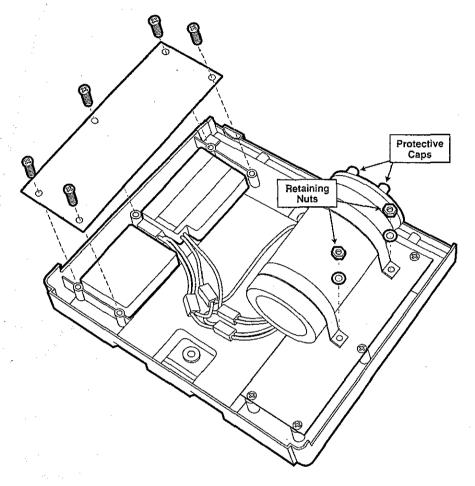


Figure 5-6. Internal Batteries / Energy Storage Capacitor

Note Note

If it has been determined that one or more of the Internal Batteries are defective, it is recommended that all four (4) be replaced as a set. A defective battery may effect the life or performance of the remaining batteries.

- 1 Per form the procedure for the removal of the ventilator top and side covers.
- 2 To remove the batteries, refer to Figure 5-6 to remove the five (5) screws from the batter y retaining plate.

Internal Batteries (P/N 68093) (Continued) Energy Storage Capacitor (P/N 64084) (Continued)



To remove the batteries from the left side of the top cover, the large capacitor must be removed first.

3 To remove the Energy Storage Capacitor , remove two (2) of the nuts from the restraining straps, remove the electrical connections, and slide the capacitor from the straps.



When installing the capacitor, ensure that the white wires are connected to the positive (+) terminal and the black wires are connected to the negative terminal. Also note that the vent plug on the capacitor must be orientatied towards the top of the ventilator. Ensure protective caps are reinstalled on the capacitor terminals.

Motor Controller PCBA (P/N 71597)

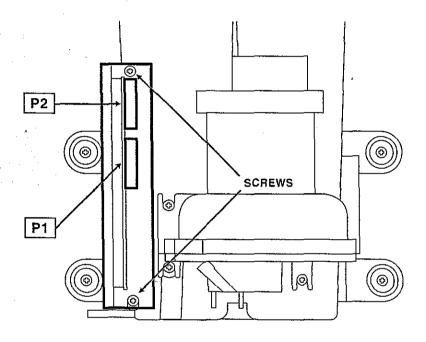


Figure 5-7. Motor Controller

- 1 Per form the procedures to remove the top and side covers from the ventilator
- 2 Referring to Figure 5-7, remove connector P1 (coming from the T urbine) and P2 (coming from the Power Supply) from the Motor Controller noting the edges that engage the locking tabs.
- 3 Remove the two (2) screws securing the Motor Controller bracket to the muf assembly.
- 4 Place the PCB in appropriate anti-static packaging for shipment.



When connector P2 is installed, a small electrical spark may be noticed. This is normal due to a residual charge remaining on system capacitors.

Watch Dog PAL (15532)

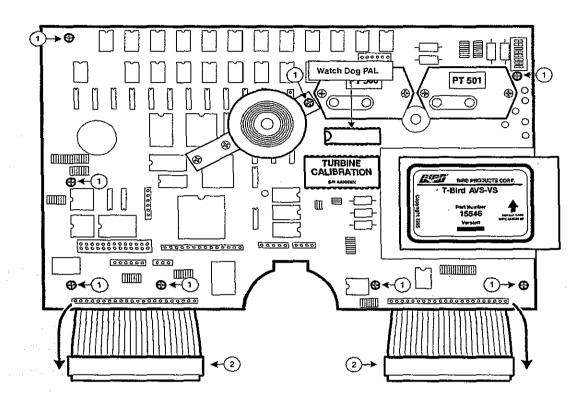


Figure 5-8. Main PCB, Watch Dog PAL

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Referring to Figure 5-10 Ref. 1, remove the two (2) screws that secure the front panel assembly to the ventilator base and rock the front panel for ward.
- 3 Referring to Figure 5-8, locate the W atch Dog P AL on the Main PCB.
- 4 Using an IC extraction tool, remove the P AL and place the chip in appropriate anti-static material.
- 5. Install the new P AL using caution as to proper pin alignment and position of pin 1 indicated by the notch in the P AL IC. <u>Do Not</u> rely on the orientation of the label for IC installation.

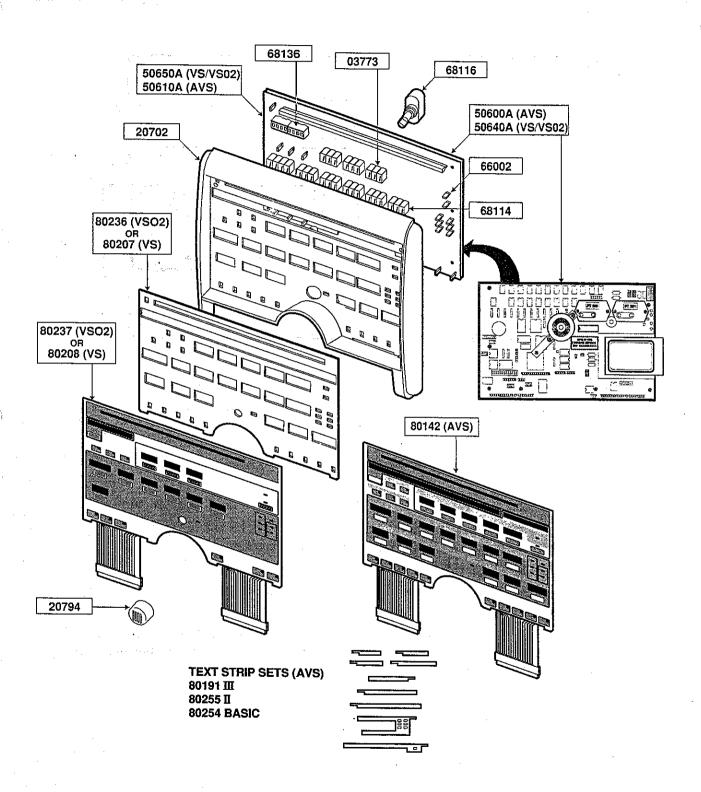


Figure 5-9. Front Panel Disassembly

Panel Encoder Assembly - P/N 68116
Main PCBA - P/N 50640A (VS/VSO2) or P/N 50600A (AVS)
Display PCBA - P/N 50650A (VS/VSO2) or P/N 50610A (AVS)
Front Panel - P/N 20702
Control Panel - P/N 80207 (VS) or P/N 80236 (VSO₂)
Overlay - P/N 80208 (VS) or P/N 80237(VSO₂)
Control Panel/Overlay - P/N 80142 (AVS)

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 To remove the Front Panel Encoder: Refer to Figure 5-9.
 - a) Remove the electrical connector from the rear of the panel encoder noting orientation.
 - b) Pull on the knob P/N 20794 to remove it from the encoder shaft.
 - c) Per form the procedure to remove the front panel and overlay from the ventilator without unplugging the cables to the Main PCB.
 - d) Using a 1/2" nut driver or socket, remove the mounting nut from the encoder P/N 68116 and remove the panel encoder through the inside of the ventilator

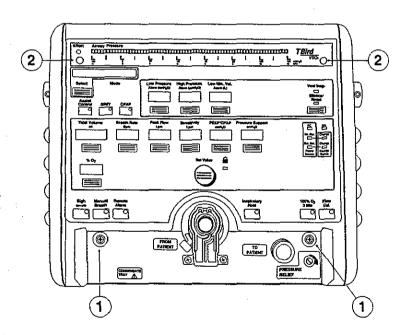


Figure 5-10. Front Panel Encoder Removal

- To remove the control panel and overlay:
 - a) Disconnect the two (2) ribbon cables in the lower corners of the Main PCBA. (Refer to Figure 5-9.)

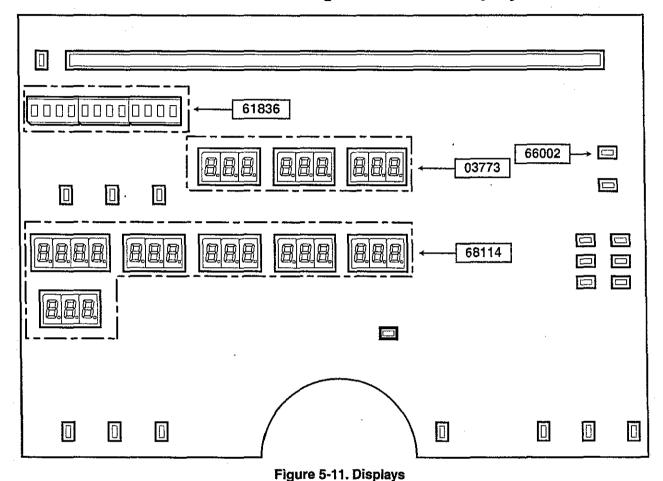
- b) Remove the two (2) screws from the upper corners of the control panel (Refer to Figure 5-10 Ref. 2).
- c) Using a small screwdriver in the screw holes, pull the upper edge of the control panel foward and up to disengage the retaining tabs at the bottom of the panel.
- d) Gently remove the control panel with par ticular attention to the ribbon cables as they clear the slots in the front panel.
- 4 To remove the Main PCBA or Display PCBA:
 - a) Disconnect the pneumatic and electrical connections from the Main PCBA.
 - b) Remove the two (2) screws from the lower par t of the front panel (Refer to Figure 5-10 Ref. 1) and remove the front panel from the ventilator
 - c) Remove the eight (8) screws securing the Main and Display PCBs to the front panel. Note that one (1) mounting screw is on the alarm. (Refer to Figure 5-8, Ref 1.)
 - d) Disconnect the two (2) ribbon cables attached to the lower corners of the Main PCBA. (Refer to Figure 5-8, Ref 2.)
 - e) Remove the Main and Display PCBs from the front panel.
 - f) Gently disengage the connector in the lower left corner of the of the two (2) PCBs.



If returning the Main PCBA, do not return the Memory Cards or the Turbine Calibration EEPROM unless instructed to do so.

- g) Place the PCB in appropriate anti-static packaging for shipment.
- 5 To remove the front panel:
 - a) Complete the 3 procedures at the beginning of this section.

7 Segment Red Display (P/N 03773)
Dot Matrix Displays (P/N 68136)
Socketed LED (P/N 66002)
7 Segment Yellow Display (P/N 68114)



- 1 Per form the procedure to remove the covers from the ventilator
- 2 After labeling or noting positions, remove the cables and pneumatic connections from the Main PCBA.
- 3 Per form the procedure for the removal of the Display PCBA.
- 4 Remove and replace the malfunctioning display element obser ving polarity and proper engaging of pins.

Muffler/Filter Core Assembly (P/N 10365)

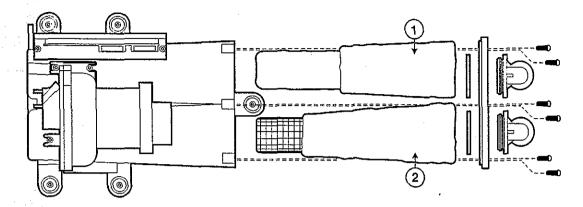


Figure 5-12. Muffler/Filter Core Assembly

- 1 Per form the procedure to remove the right side cover from the ventilator
- 2 Remove connectors J1 and J5 (refer to Chapter 6, Schematics) from the Power Supply PCBA.
- 3 Swing the right side cover away from the unit.
- 4 Referring to Figure 5-12, remove the six (6) screws holding the end caps on the muffler tube and remove the caps and elbows as an assembly .
- 5 Using a pair of pliers, grasp the inner screen of the rear filter (Ref. 1) and using a clockwise pulling motion, remove the element from the tube.
- 6 Referring to Figure 5-12, inser the element with the filter into the tube using a clockwise insertion motion.
- 7 Remove and replace the remaining element (Ref. 2) as described above.



Before assembling the ventilator, be sure to double check the alignment of connector J5. Misalignment of this connector can cause catastrophic damage to the Power Supply and/or the Main PCB.

Exhalation Valve - (P/N 15429)

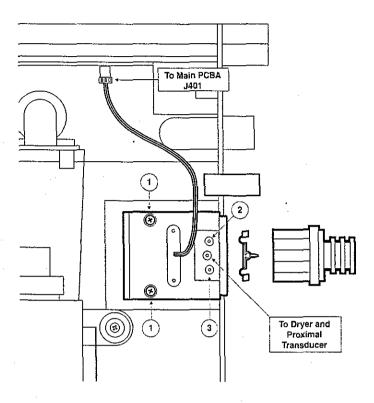


Figure 5-13. Exhalation Valve

- Per form the procedure to remove the top and side covers from the ventilator
- 2 Remove the Exhalation Body and Exhalation Diaphragm from the ventilator

Note

Referring to Figure 5-13, the two outside tubes should be labeled as 2 and 3 with plastic bands. If they are not, label these tubes with masking tape or make a drawing for correct assembly.

- Remove the three (3) pneumatic tubes to the Exhalation V alve, labeling or noting their position for proper assembly .
- 4 Unplug the cable going to the Main PCBA, (refer to Chapter 6, Schematics, pg. 6-1) noting the orientation of the connector
- 5 Remove the two (2) Phillips screws (Figure 5-13, ref. 1) from the top of the Exhalation Valve.
- 6 Lift the Exhalation Valve back and up to remove it from the ventilator

Turbine Assembly - (P/N 15430A) (Includes Turbine EEPROM and Cable)

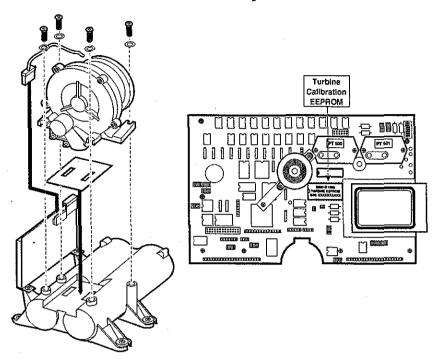


Figure 5-14. Turbine Assembly

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Unplug the connector J701 (refer to Chapter 6, Schematics, page 6-1) from the Main PCBA.
- 3 Unplug connector P1 (refer to Chapter 6, Schematics, page 6-1) from the motor controller noting orientation.
- 4 Label and remove the two (2) pneumatic connections from the turbine.
- 5. Referring to Figure 5-14, remove the four (4) screws from the base of the turbine.
- 6. Lift the turbine assembly from the muf fler tube, retaining the silicone gasket under the turbine for re-use.
- 7. Using masking tape, cover the inlet and outlet openings of the turbine and the muffler tube to prevent the entrest of foreign material into the assemblies.
- 8. Using the EEPROM removal tool, remove the EEPROM from the Main PCBA and place into appropriate anti-static material.
- 9. Referring to Figure 5-14, install the new turbine EEPROM making sure that the notch is facing to the left and that pins are properly aligned and engaged. Do not rely on the position of the label for installation.
- 1). After installing the new turbine it will be necessary to enter the turbine serial number into the ventilators memor y. Refer to Chapter 3, SVT , of this manual for instructions.

Blender Assembly - (P/N 15581) (TBird™ VSO₂ and AVS)

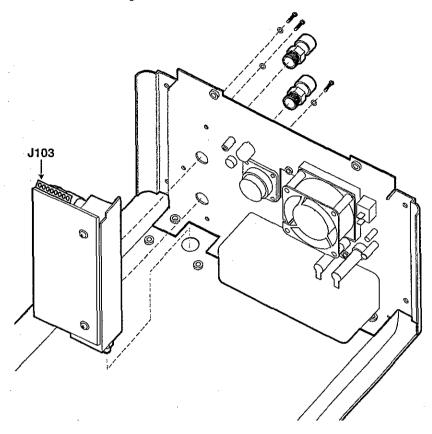


Figure 5-15. Blender Assembly

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Remove the Rear Inlet Filter .
- 3 Reaching in through the filter cavity with needle nose pliers, disconnect the hose coming from the base of the blender
- 4 Remove the electrical connector J103 from the blender noting orientation.
- 5 Referring to Figure 5-15, remove the pair of O ₂DISS fittings from the rear of the ventilator. Take precaution not to lose springs within the fittings.
- 6 Remove the two (2) screws from the rear of the ventilator that secure the blender to the chassis.
- 7. Lift the blender from the ventilator .
- 8 After installation of the replacement blender , per form the Oxygen Pressure Transducer calibration as described in Chapter 3, SVT , of this manual.

Fan Assembly - (P/N 15500) Fan Inlet Filter - (P/N 33749) Fan EMI filter - (P/N 33759)

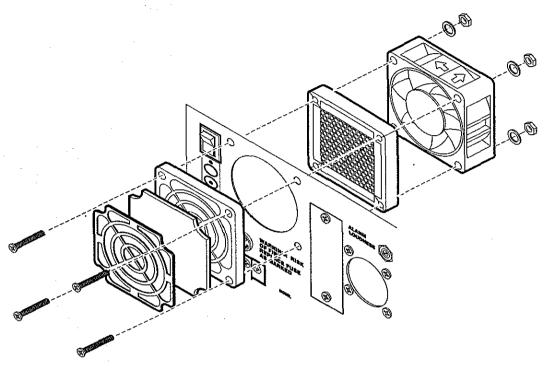


Figure 5-16. Fan Assembly

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Unplug the fan cable from the Power Supply connector J2 (refer to Chapter 6, Schematics, page 6-1).
- 3 Referring to Figure 5-16, remove the four (4) screws and nuts securing the assembly to the back panel.
- 4 When installing the new component, ensure that the rear fan grill is oriented to allow the filter retainer to snap out for cleaning of the filter
- 5 If a new fan is being installed, ensure that the direction of air flow is into the ventilator as indicated by the arrow on the fan housing.

Patient Assist Call - (P/N 50570)

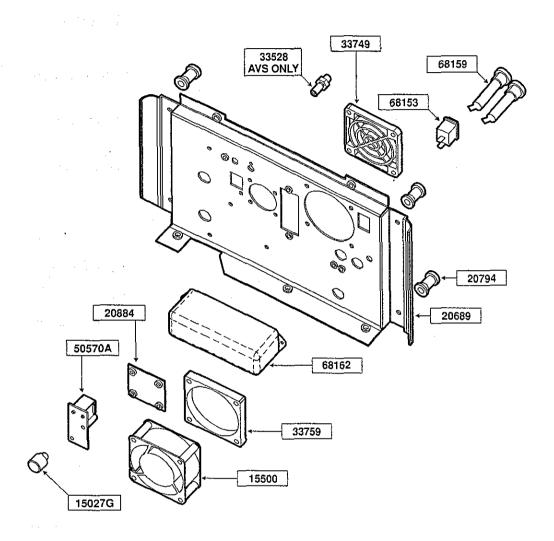


Figure 5-17. Patient Assist Call

Refer to Figure 5-17.

- 1. Per form the procedure to remove the covers from the ventilator
- Locate and remove the electrical connector from the Patient Assist Call PCBA, P/N 50570A noting its orientation.
- 3. Remove the two (2) screws securing the Patient Assist Call PCBA, P/N 50570A to the standof fs on the rear panel.
- 4. Remove the Patient Assist Call PCBA from the ventilator

Standby/On Switch - (P/N 68153)

Refer to Figure 5-17.

- 1. Per form the procedure to remove the top and side covers from the ventilator
- 2 Disconnect the brown and black wires from the switch.
- 3. Compress the retaining tabs on the top and bottom of the switch and slide it out of the rear of the ventilator .
- 4. Noting correct orientation, inser the new switch into the ventilator with the electrical connections towards the bottom of the unit.
- Attach the brown and black wires to the switch and test for proper operation.

Fuse Holder - (P/N 68159)

Refer to Figure 5-17.

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Noting their location, remove the two (2) wires from the fuse holder
- 3 Loosen and remove the large nut on the inside of the back panel that secures the fuse holder to the panel.
- 4 Remove the fuse holder from the unit.

Alarm Loudness Potentiometer - (P/N 15027G)

Refer to Figure 5-17.

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Unplug the alarm loudness cable from the Main PCB.
- 3 Remove the alarm loudness mounting nut from the rear of the unit and remove the control.

EMI/RFI Filter - (P/N 68162)

Refer to Figure 5-17.

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Disconnect the wires from the filter and note the location.
- 3 Remove the two (2) nuts securing the filter to the rear of the ventilator and remove the filter from the ventilator .

Turbine Differential Pressure Transducer - (P/N 68125) Exhalation Differential Pressure Transducer - (P/N 68126)

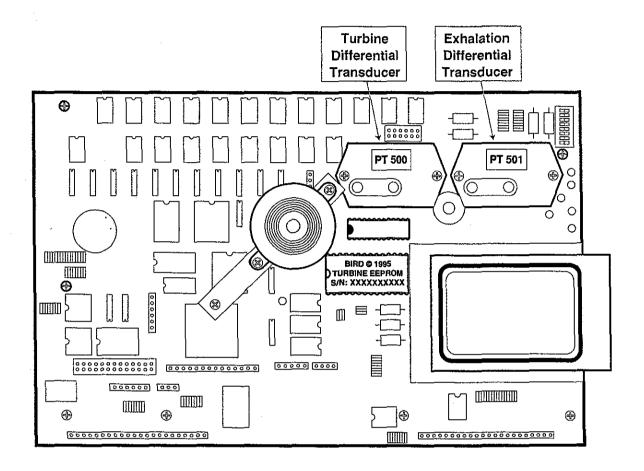


Figure 5-18. Turbine Differential Pressure Transducer and Exhalation Pressure Differential Transducer

- 1 Per form the procedure to remove the top and side covers from the ventilator
- 2 Referring to Figure 5-18, label or note the position of the pneumatic connections to the pressure transducer and remove them.
- 3 Remove the two (2) screws retaining the pressure transducer to the Main PCBA.
- 4 Unplug the pressure transducer from the Main PCBA.
- 5 After installing the new transducer per form the transducer calibration procedure as described in Chapter 3, SVT , of this manual.

Base Plate O-Rings Anti-Suffocation Valve

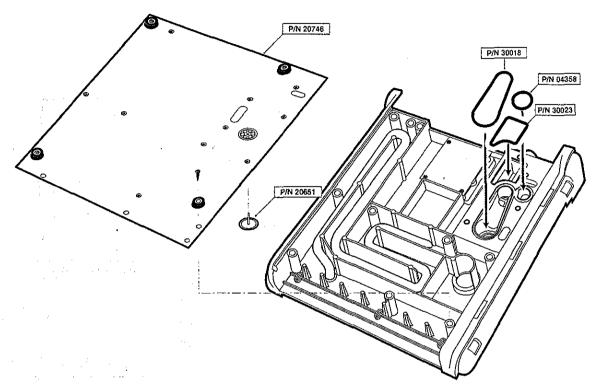


Figure 5-19. Base Plate O-Rings and Anti-Suffocation Valve

- 1 Place the ventilator upside down on the work surface.
- 2 Referring to Figure 5-19, remove the four (4) rubber bumpers from the base plate.
- 3. Remove the ten (10) screws securing the base plate to the ventilator chassis and remove the base plate.
- 4. If replacing the base plate o-rings, inser them into the lands as shown.
- 5. If replacing the anti-suf focation valve, place the tail of the valve from the inside of the base plate and pull the tail through using caution as not to break the tail.

t

Outlet Check Valve Assembly Relief Valve Assembly

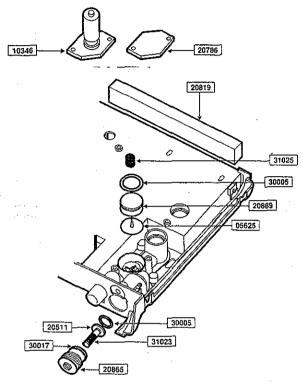


Figure 5-20. Outlet Check Valve Assembly and Relief Valve Assembly

- 1 To replace components of the Outlet Check V alve Assembly:
 - a) Per form the procedure to remove the right cover from the ventilator
 - b) Referring to Figure 5-20, remove the cover plate (P/N 20786) using a shor Phillips screwdriver and withdraw the components.
- 2 To replace components of the Relief V alve Assembly:
 - a) Per form the procedure to remove the top and side covers from the ventilator
 - b) Per form the procedure to remove the front panel from the ventilator
 - c) Referring to Figure 5-20, back out the Relief V alve Adjuster (P/N 20865) and remove it and its components from the ventilator .
 - d) When installing the Relief V alve, insure that the adjuster is screwed in sufficiently to avoid interference when the Front Panel is installed.

EXTERNAL DOCKING BAY



Installation of the External Docking Bay requires access to the interior of the ventilator. It is intended to be performed by a Bird Certified Service Technician who is trained to work on the TBird Ventilator Series. Improper installation of the Docking Bay can damage the ventilator and void the warranty.

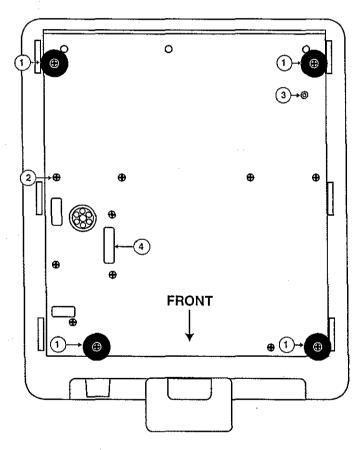


Figure 5-21. Ventilator Base

- 1 Remove the ventilator from external AC and ensure that the power switch is in the Standby position.
- 2 Turn the ventilator upside down and set it down on its top.
- 3 Referring to Figure 5-21, remove the following from the base of the ventilator:
 - Four (4) Rubber Bumpers Ref. 1
 - Two (2) Screws-Ref. 2 & 3

- 4 Remove the external batter y pack from the docking bay if installed.
- 5 Position the docking bay above the base of the ventilator
- 6 Using the screw provided, attach the green/yellow wire with the ring terminal to the nut inser tindicated in Figure 5-22, Ref. 1.

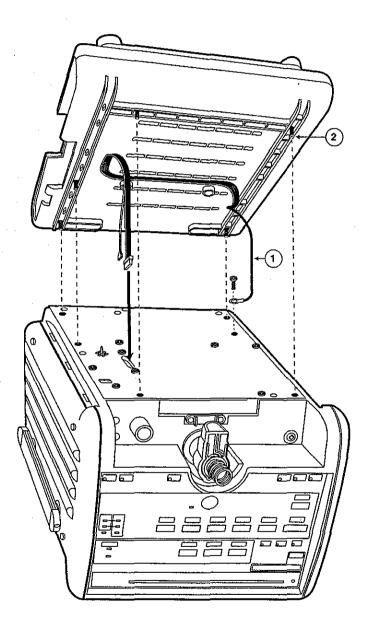


Figure 5-22. Docking Bay Assembly

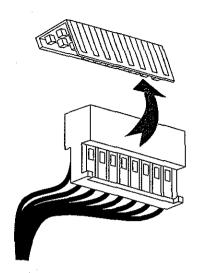


Figure 5-23. 8 Position Connector

- Referring to Figure 5-23, remove the white plastic cover from the 8 position connector.
- Star ting with the 8 position connector , pass the cables from the docking bay through the slot in the base of the ventilator indicated in Figure 5-22.



CAUTION SAFRE



When aligning the docking bay on the bottom of the ventilator, ensure that the cables are not pinched between the upper and lower mating surfaces.

- 9 Referring to Figure 5-22, align the captive retaining screws Ref. 2 with the mounting inser ts where the rubber feet and screw Figure 5-21, Ref 2 were removed and tighten with the Phillips screwdriver .
- 10 Turn the ventilator back to the upright position.



The power supply of the ventilator is mounted to the side cover that is about to be removed. Pull it away from the ventilator slowly so as not to dislodge any electrical connections.

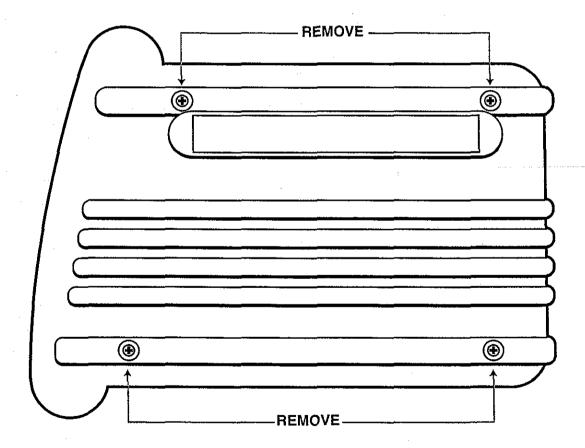


Figure 5-24. Right Side Cover

11 Remove the four (4) screws from the right side of the ventilator as shown in Figure 5-24.